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CONTENTS

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Original Articles

CEPHALOMETRIC ROENTGENOGRAPHY AND THE DENTIST

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INTRODUCTION

THE Broadbent-Bolton roentgenographic cephalometer was presented to the profession thirteen years ago by an orthodontist, as a specific technique for the investigation of craniofacial growth and for the quantitative study of the results of orthodontic treatment. Since then, and particularly in recent years, it has become increasingly evident that the technique is useful not only in orthodontics and the academic study of growth, but also in other fields of dentistry. One might think that a discussion of cephalometric roentgenography in dentistry should present the subject without placing primary emphasis on growth, in order to concentrate on phases of general interest. No sooner does one attempt to organize his thoughts than he realizes, however, that a single tool for the study of human morphology cannot be divorced from the subject itself, and that it is presumptuous to launch *in medias res* into a single phase without some acknowledgement of the ramifications of the whole.

Growing up—at least in the physical sense—is an experience shared by all. Some of us have had the privilege of observing it in our children. Because the dentist who works only with adults deals with the end product of growth and development, and because orthodontic treatment is carried on the tide of growth, the rationale and techniques of cephalometry should be discussed within the framework of the study of growth and development.

The first requisite of a discussion is a definition of terms. The words "growth" and "development" carry different connotations for different people, and may be used quite properly in different ways. Those working in the field of human morphology generally accept the definition of the White House Conference of 1931: *growth* is increase in size, *development* is progress toward maturity. As Todd has so succinctly put it, when we say, "Johnny is not big enough to reach the top shelf," we are talking about growth, but when we say,

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Read before the First Annual Seminar for the Study and Practice of Dental Medicine, Del Monte Lodge, Pebble Beach, Calif., Oct. 18, 1944.

"Johnny is not big enough to be interested in girls," we are talking about development. Much of the field of development, under these definitions, is left to the psychologist, although changes in proportion which accompany increases in size are signposts of development and are therefore of definite interest to the morphologist.

There are two basic approaches available for the scientific study of growth and development. The first of these is the horizontal or cross-sectional approach, which consists of measuring and examining a large number of individuals of, say, one year of age (the group chosen is called the *sample*) repeating the same procedure with a group of two-year-olds, then three-year-olds, etc. Means and other statistical parameters are calculated for each of these samples, and if a careful technique has been followed, one may assume that the successively changing characteristics observed on progressively older samples are due to age differences alone, and that the picture which unfolds is that of growth itself. Under this plan of attack, with a large enough force of investigators, a great deal of scientific ground can be covered in a relatively short time. Many individuals contribute to the formulation of a mass value, which speaks for each individual in the group. Sometimes in applying the knowledge so derived, because in practical applications we work always with individuals rather than the mass, we are compelled to resort to a sort of backtracking which may be dangerous.

We may, on the other hand, use the longitudinal approach, sometimes called the serial or vertical. Here we follow the same group of subjects throughout their growth span, recording their actual increments and changes, rather than relying on a statistical method in which heavy trust is placed in averages. If we elect to use the serial approach we must be patient, for it takes time for children to grow up. The anthropologist, Steggerda, while with the Carnegie Institution of Washington, conducted serial studies over many years by making annual visits to Mayan children in Yucatan, Navaho Indians in the Southwest, Negroes in Alabama, and Dutch white children in Holland, Michigan. His data included not only the usual anthropometric measurements, but mouth charts of eruption and caries as well. Broadbent, who developed the first roentgenographic cephalometer, has made serial x-rays of upwards of 4,000 Cleveland children as director of the Bolton Fund of Western Reserve University.

These two fundamental approaches to the problem may be followed with a variety of methods. Space obliges us to slight the important field of animal experimentation, to consider the methods available for the study of actual human material.

The most commonly used method is that of anthropometry. Each time you back your youngster up to the wall and mark his height on the doorjamb you are carrying out a rough-and-ready anthropometric technique. Measurements of height, weight, chest girth, and a host of other dimensions have been made by thousands of curious individuals for centuries, and their importance is obvious. The student of skeletal growth, however, finds himself limited by the covering of soft tissue which drapes the bony framework. It is possible to deduct a certain amount from soft-tissue dimensions to arrive at an estimate of the size of underlying bony parts, but this procedure of "soft-tissue correction," due to the wide latitude of individual variation, is inaccurate at best, and the most satisfactory measurements of bones are made of necessity upon bones themselves.

This brings us, then, to osteometry, the measurement of bones. There is less question of technical accuracy here, for the material is not going any place and may be checked and rechecked. Osteometry also has its serious limitations. While museums and laboratories hold abundant skeletal material of individuals who have died in the first year of life, and a plethora of adult material, there are too few skeletons of children who have died in the age ranges between one year and maturity. Another less obvious but equally important objection to the osteometric method was voiced by Todd when he said: "A dead child is a sick child." Even when one has a modest quantity of skeletal material of desirable ages, one must always consider the fact that death may have followed a prolonged illness, with the consequence that the moment of death—which is the only instant of the subject's life available to us for study—speaks but poorly for normal growth and development as it is found in radiant health.

What are we to do if we want to study the skeletons of healthy children without making soft-tissue corrections? The roentgenographic method comes immediately to mind, but it, too, must be approached with a critical eye. The study of bone maturation in the wrist, the hip, the knee, and the ankle has added greatly to our knowledge of growth and development, but it relies mainly upon subtle qualitative changes detected by a trained observer, and less upon actual quantitative values obtained from the films.

If we are to use these shadows—for that is what roentgenograms are—we must accept them as such and recognize the factors which may give artefacts. It is quite possible for us to measure the height of a man on any sunny day by measuring the shadow he casts, but if we ignore the position of the sun we shall find him a squat blob at high noon and an elongated stripling by dinnertime. Any roentgenographic technique which presumes to be quantitative must standardize the relative position of the three principal parts of the technique; the source of the rays which produce the shadow, the object which casts the shadow, and the surface upon which the shadow is thrown. We place the confidence we do in Broadbent's instrument because these three factors are completely controlled every time we seat the subject in the chair.

The physical equipment essential to this technique has been described quite adequately elsewhere in the dental literature[2] in articles which have been profusely illustrated, and an involved description here would be inappropriate. Briefly, the installation consists of an apparatus for stabilizing the head, and two x-ray tubes with the headholder and the tubes mounted rigidly with respect to one another. The subject is positioned in the apparatus by means of ear-rods and a rest at the root of the nose in such a fashion that the left orbitale is at the same level as the ear-rods, i.e., the head is placed in the Frankfort horizontal plane (See Fig. 1). One of the x-ray tubes is oriented so that its central ray travels along the superior surface of the ear-rods, and this tube sensitizes a film placed in a cassette lying immediately against the left side of the subject's face, in a plane perpendicular to the central ray of the tube and parallel to the median sagittal plane of the patient. Obviously, a lateral view of the subject's head is obtained on this film. The second tube is immovably fixed so that its central ray travels parallel to the floor in the same plane of space as does the central ray from the lateral tube, in the median sagittal plane of the subject's head. It produces the posteroanterior or frontal film, which is held in its cassette immediately in front of the patient, in a plane at right angles to the plane of the lateral cassette. Size distortion is reduced satisfactorily by using a five-foot target distance, and by shortening the object-film distance; the residual size distortion which is inevitable is measurable since the distance

from the frontal film to the ear-rod and the distance from the lateral film to the median sagittal plane are recorded for each sitting, and size correction is relatively simple.

When the two films so obtained are properly mounted on a transilluminated drafting table, they complement one another; dimensions of height and anteroposterior length may be taken from the lateral, and width may be taken from the frontal. The frontal is also helpful in distinguishing between right and left.

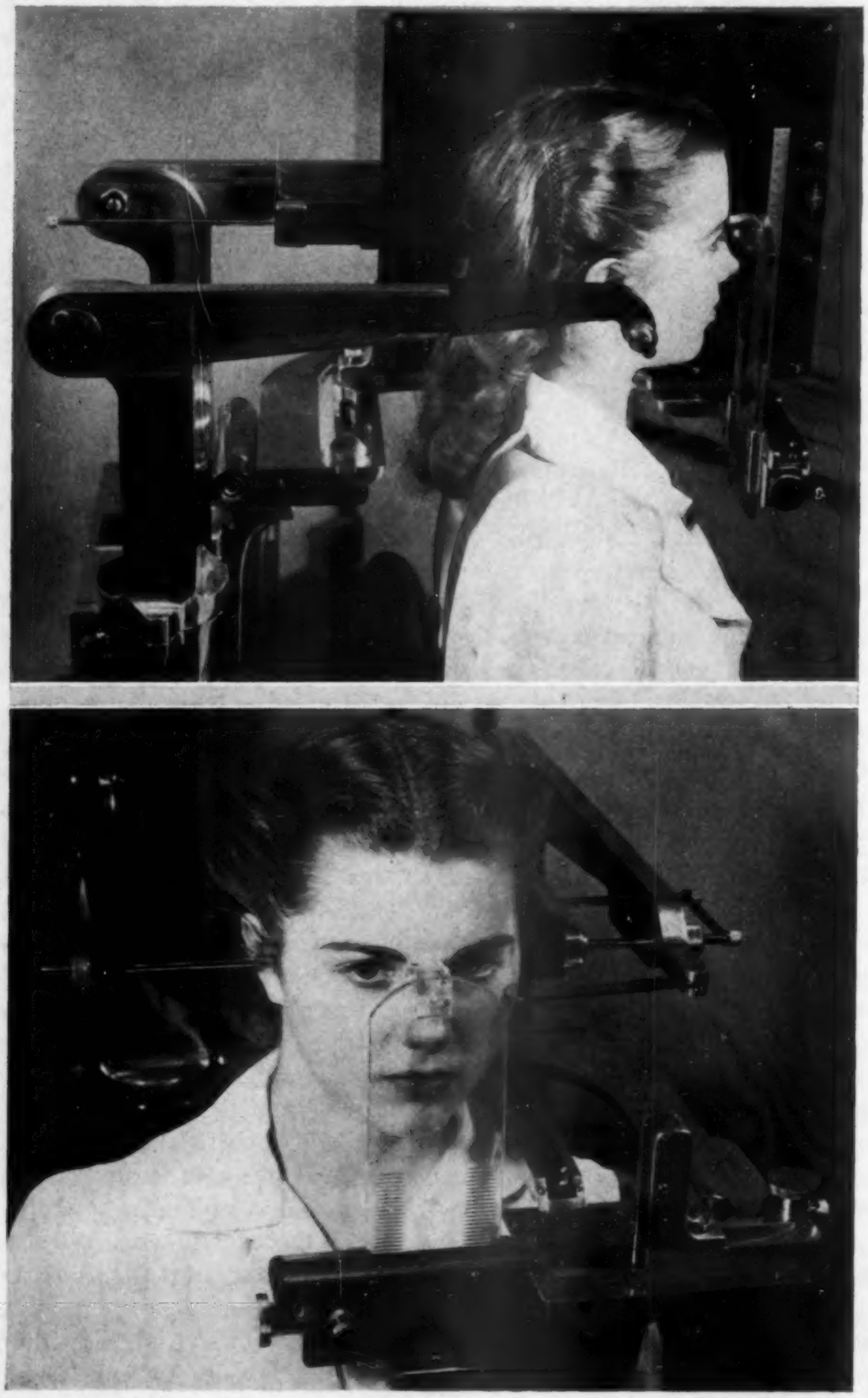

Fig. 1.—Lateral and frontal views of a patient in the cephalometer. The frontal cassette has been removed to show the orbitale pointer and the rest at nasion.

Even the hasty description above should be sufficient to show that films obtained under standardized conditions give a serial record of one individual over an indefinite period of time, and each set of films in the series is exactly comparable with every set preceding or following it. Thus the cephalometric technique makes possible the quantitative study of craniofacial growth by means of the *longitudinal* approach. Furthermore, different individuals may be x-rayed by means of this instrument, and since they are oriented to the apparatus in like fashion, their films are comparable and may be used in a *horizontal* study, of not only growth, but of any other problem in human craniofacial morphology.

At the University of California, following the lead of the Illinois group, we have adopted as a standard set of films one frontal in the physiologic rest position, one lateral in physiologic rest, a lateral in centric occlusion, and a lateral with the mouth wide open. The open position throws the head of the condyle forward on the articular eminence so that its outline is clearly seen on the film; when the jaw is closed the condyle is too often obscured by the apparatus. The significance of the physiologic rest films will be touched upon later.

While the films themselves are of great help in a diagnostic way and serve to afford a quick impression of conditions underlying the soft parts, quantitative procedures depend upon accurate tracings which are made from the films. It is quite proper for one to build up the content of one tracing by adding material from more than one film—for example, we may add to all of the lateral tracings the outlines of the mandibular condyles which are seen most clearly in the wide-open view.

THE NATURE OF GROWTH

Before considering the analysis of growth in cranium and face by cephalometric means, an important characteristic of bone growth should be examined. Although bone is a living tissue, its physical properties oblige us to turn to non-living forms for analogous patterns of growth. A cross section of stalactite cut thin enough to transmit light will reveal an accretional growth pattern which is not unlike that of bone; concentric lamellations depict the course of growth in this stone pendant, and show clearly that increase in bulk takes place only on free surfaces. Indeed, one cannot imagine any mechanisms of growth which would permit this stalactite to expand from its innermost portions. Tree rings are annual milestones in the growth of the diameter of the tree's trunk; here again the internal portions are unyielding and the physical structure is self-limiting except for accretional growth on free surfaces. No other mode of growth in a hard, unyielding body is conceivable, and so it is with bone. We say, therefore, that bone growth takes place on free surfaces, and that *interstitial* bone growth cannot account for increase in the size of skeletal parts; every explanation or hypothesis of skeletal growth must satisfy this axiom.

The accurately oriented head film shows us changes in over-all pattern which take place in growth, but we want also to know exactly where growth takes place—does it take place all over, with the face expanding like an inflating balloon, or is growth limited to specific sites? The roentgenographic technique cannot tell us where growth takes place, except in locations where the growth site differs from the remainder of the bone, such as the epiphyseal plate of a long bone, which is dark in the film. In the head there are only two such sites, the spheno-occipital junction and the spheno-ethmoidal junction, and in the face there is none. We must, therefore, discover the sites of growth by means of a

qualitative method which will augment our quantitative data from the cephalometer.

VITAL STAINING

The discovery of a vital stain for the elucidation of growth sites was due to an accident. Back in the days of the American Revolution, the color Turkey red in calico dress goods enjoyed popularity among London matrons. The color was put into the cloth by soaking the fabric in a mixture of madder root and bran. The name of the dyer who figures in the story has been lost, but when it turns up it will undoubtedly have a Scotch ring to it, for he did not empty the exhausted dyestuffs from his vats into the sewer, but fed the bran to his pigs. One evening he invited a young physician named Belchier over for dinner, and regaled him with pork. At the end of the meal Belchier noticed that the ring of bone remaining on his plate showed concentric rings of red and white. Upon experimentation he found that the bone which was laid down during a period of madder feeding was stained red, and that bone deposited before and after the feeding had its natural color. Madder feeding experiments were carried on almost immediately by John Hunter, and in modern times by Brash[1]; Massler is currently engaged in such studies, using the active principle, alizarin red S, in the macaque monkey.[11, 12] From these studies it has been shown that in the early years of postnatal life bone is deposited on all free surfaces, but that later only localized sites contribute to the growth of the cranium and face, among which are: the sutural borders of flat bones, the posterior border of the mandible, the frontonasal process and the tuberosity of the maxilla, the inferior surface of the hard palate and the transpalatal suture, the head of the mandibular condyle and the semilunar notch, and the alveolar bone about the teeth. A concomitant process of resorption holds bulk in check and maintains proportion.

Vital staining with alizarin has been linked with the method of cephalometry in such a way that the processes of facial growth come into sharp focus; the first procedure answers the question "Where?" and the second answers the question "How much?" An excellent example of the fusion of these two research methods as applied to a specific problem is the work of Carlson[9] in which the rate and amount of eruption in mandibular human teeth were studied. Since it has been shown that there is in growth no deposition of bone on the lower border of the mandible, Carlson could demonstrate exact relationships of individual teeth to the mandible and to other mandibular teeth during the three phases in the life of the tooth: the development stage as it lies in the crypt, the period of active eruption, and the period of passive eruption.[9] For this work, Carlson was awarded first prize in the essay contest sponsored by the American Association of Orthodontists in 1944.

THE CONCEPT OF PATTERN

So far we have taken up the manner in which bone is laid down, the recognition of specific sites and their detection by vital staining, and the quantitative assessment of the contributions of various sites by cephalometric means. When we speak of "pattern" we refer to the over-all picture of craniofacial growth, that is, the movements of various parts of the face in relation to one another during growth. For instance, does the lower part of the face grow at a greater rate than the upper part? This has actually been postulated in the past, and the concept is important, for if certain parts must attain a larger part of their growth potential postnatally then do others, those parts will be most affected by prolonged illnesses, and pattern will be altered during growth.

Broadbent has demonstrated the behavior of facial pattern in growth by means of superpositions; superpositioning consists of laying one tracing upon others in a standardized fashion so that change may be studied. The different methods of superposition and the justification for each is a subject for a paper itself; after a statistical study of craniofacial growth Broadbent concluded that a point which he calls *R*, situated in the body of the sphenoid bone and readily located by connecting certain points with straight lines, is the best point for orienting these tracings to one another.

Perhaps the most striking thing to be observed in the craniofacial growth pattern is its constancy. This constancy is evident in Broadbent's[3-5] superpositions as he chronicles the perennial miracle of growth from birth to adulthood; the successive pictures of upper and lower incisors, chin-point, gonial angle, etc., show each of these structures moving along a straight line as the facial mask descends downward and forward from beneath the cranium.

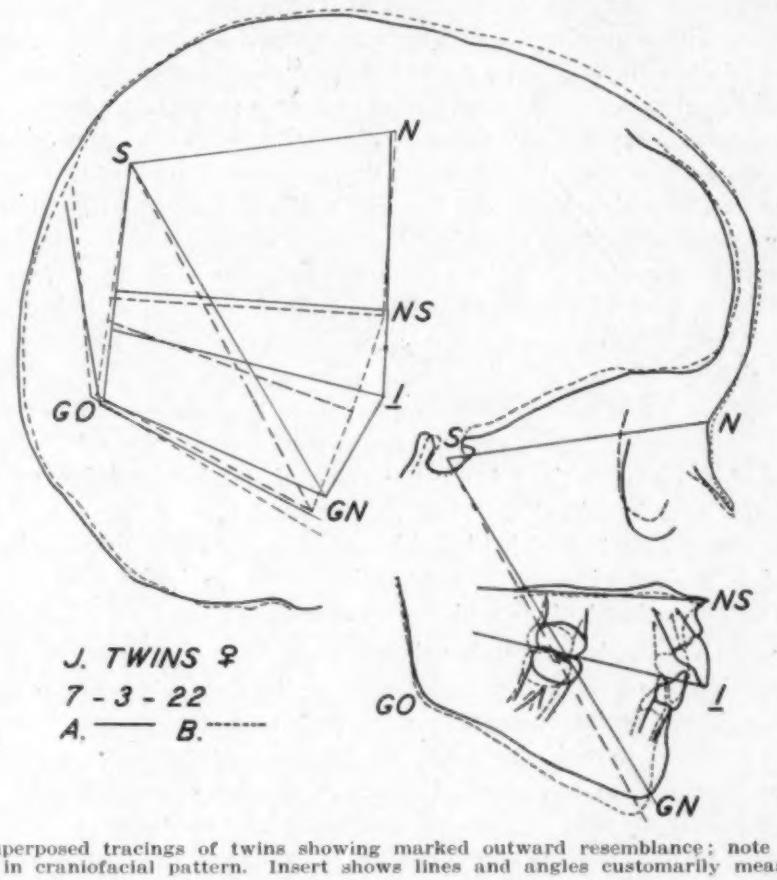

Fig. 2.—Superposed tracings of twins showing marked outward resemblance; note the differences in craniofacial pattern. Insert shows lines and angles customarily measured.

Brodie,[6] in an exhaustive study of human craniofacial growth, studied pattern in a slightly different way. Salient landmarks in the craniofacial complex (see Fig. 2) were connected with straight lines; the length of each line gave the distance between the two points, and the intersection of two lines formed an angle. No only did he examine the absolute increase in length of each line, but also the relative changes in all dimensions. The magnitude of each angle was followed through successive films to discover whether or not specific trends were present which would be revealed by a steady increase or decrease in the magnitude of angles. So orderly is the process of growth that it was discovered that these angles remain the same in one individual from birth to ma-

turity, and since this is true it would be logical to assume that the ratio between any two lines would remain the same. The data show the assumption to be correct, and due to Brodie's researches it may be said definitively that the craniofacial pattern is established by the time of birth and thereafter does not change. Armed with this assurance, the writer[14] was enabled to devise a quantitative method for comparing craniofacial pattern in different individuals; proposed originally as a useful technique in the study of familial resemblance, it is equally applicable wherever it seems desirable to compare facial morphology of different individuals in a precise fashion. Fig. 2 shows twin girls who could be distinguished from one another only by members of the family, who at the same time showed pronounced differences in craniofacial pattern.

Brodie went on to show that this constancy of pattern applies not only to normal children, but to abnormal cases as well.[7] Three cases from his report may be singled out: First, a girl with the facial abnormality designated as "Vogelgesicht," a downward and backward warping of the facial mask, in whom the condition neither improved nor worsened over a five-year period. There was another unusual case in which normal and abnormal could be seen in one individual—one gonial angle rendered obtuse by intrauterine pressure[7] until ramus and body were almost a straight line, with the other side normal. Each side of the face maintained over a six-year period the pattern seen in that side at the first examination. The last of Brodie's cases to be cited recalls the old saying about exceptions proving the rule—although this case established the observation about craniofacial constancy, and was only an apparent exception. At the age of 12 years this girl developed a bilateral ankylosis of the temporomandibular joint, necessitating the removal of both condyles. Studies of growth sites by the use of vital staining reveals that the head of the condyle is one of the last growth sites in the human face to show a cessation of growth, and that it functions as a sort of "take-up mechanism" for all of the growth sites situated anterior to it. After the removal of the condyles, growth continued in the anterior sites, carrying the forward half of the face downward, but the posterior half lagged behind with a consequent warping of the pattern, manifested in a deepening of the antegonial notch and continued alteration in the angle of the occlusal plane and the orientation of the body of the mandible.

Too much emphasis cannot be placed upon the importance of this fundamental fact that the morphogenetic pattern of the face is remarkably constant. It is now evident that misadventures of postnatal life—unless they actually eliminate an active growth site from the pattern—cannot alter proportions in the human face, although over-all diminution of size is possible. In the light of this it becomes necessary to re-evaluate many of the concepts that have previously been held regarding the etiology of malocclusion and the effects of orthodontic treatment upon the growth of the over-all pattern. Particularly when so many of these older views are based on a priori method, it may be categorically said that the burden of proof is upon their adherents when these views conflict with the objective findings of Brodie and his co-workers.

APPLICATIONS IN CLINICAL DENTISTRY

It is an interesting fact that the cephalometric technique has been a valuable aid in studying the head of the condyle and the temporomandibular joint, an area which seems at first thought to be poorly revealed in cephalometric films. We have admitted that the portion of the apparatus which stabilizes the head obscures the external auditory meatus and the joint, and this deficiency

is apparent in the films. We remedy this by taking a lateral film with the mouth wide open, which brings the head of the condyle forward far enough to record its shadow; the tracing of this film makes it possible to supply the outline of the condyles in tracings of films taken at physiologic rest and in occlusion. In doing this we obtain accurate knowledge of the movements of the head of the condyle in different positions.

The best visualization of the temporomandibular joint is given, of course, by the tomogram or laminagram; the views obtained with this instrument actually amount to serial sections taken at different levels, and show not only the condyle but the fossa as well. Unfortunately it portrays only a limited area, and the precision of orientation available in the cephalometer which makes quantitative comparison valid is not afforded by the laminagraphic technique.

The roentgenographic cephalometer has, then, gone considerably beyond its original role of recording serially the progress of craniofacial skeletal growth; in discussing some of its clinical applications we shall touch upon the amount of accommodation provided in the temporomandibular joint, the influence of the occlusion of the teeth upon the position of the condyle in the fossa, the vertical dimension in full prosthesis and reconstruction work, and the appraisal of candidates for surgical procedures.

It is obvious that there is some range of movement of the head of the condyle in the temporomandibular joint, for it may be detected in routine examination of patients, and some orthodontists take advantage of it in treating distoclusion or Class II cases. Thompson[13] has shown that this range of movement must be considered in the diagnosis of normal and abnormal position of the mandible, and that the cephalometer is valuable in making such a diagnosis. The physiologic rest[8] position of the mandible, maintained by a balance between the various muscles attached to that freely suspended bone, is constant in each individual and is therefore a logical point of departure in establishing whether or not maxilla and mandible bear a normal relation to one another. As the mandible closes from the rest position into centric occlusion, the normal path of movement of the chin-point is upward and forward, with the point of rotation in the head of the condyle. In the majority of cases, where overbite is not deep, the mandible follows the arc of closure predictable from a physiologic rest film. In some deep overbite cases, particularly in Class II, Division 2 malocclusion, the mandible follows this arc until the mandibular incisors strike the lingual surfaces of the maxillary incisors. At this point the maxillary teeth function as an inclined plane—a mechanism as effective as it is simple—to drive the mandible upward and backward bodily until the posterior teeth are in full occlusion. Fig. 3 shows the shift which takes place in one patient as the teeth are brought into occlusion; so marked is this displacement that the dental arch relationship is Class II (distal relation of the mandibular arch by the width of one premolar), yet if the normal arc of closure were followed there would be a normal jaw and dental arch relationship. This pronounced effect of the occlusion of the teeth upon jaw relationships as originally described by Thompson makes understandable a clinical observation which has in the past been poorly explained. Some of these Class II, Division 2 cases show an almost miraculous correction of the jaw relationship soon after treatment is begun. An explanation sometimes offered was that the maxillary incisors served as a "brake" upon mandibular growth, and that once it was removed a "growth spurt" took place in the mandible. It is evident now that the mandible is unchanged in size and proportion in this brief period of treatment, but through the removal of mechan-

ical interference, permitted to assume its normal position in relation to other facial parts.

The tracings in Fig. 3 show clearly the displacement of the condyles which occurs; this is observed frequently enough, in patients who complain of joint and ear symptoms, that there seems to be reason to suspect that in some individuals their troubles arise not so much from impingement through overclosure as from upward and backward pressure of the condylar head due to occlusal interference.

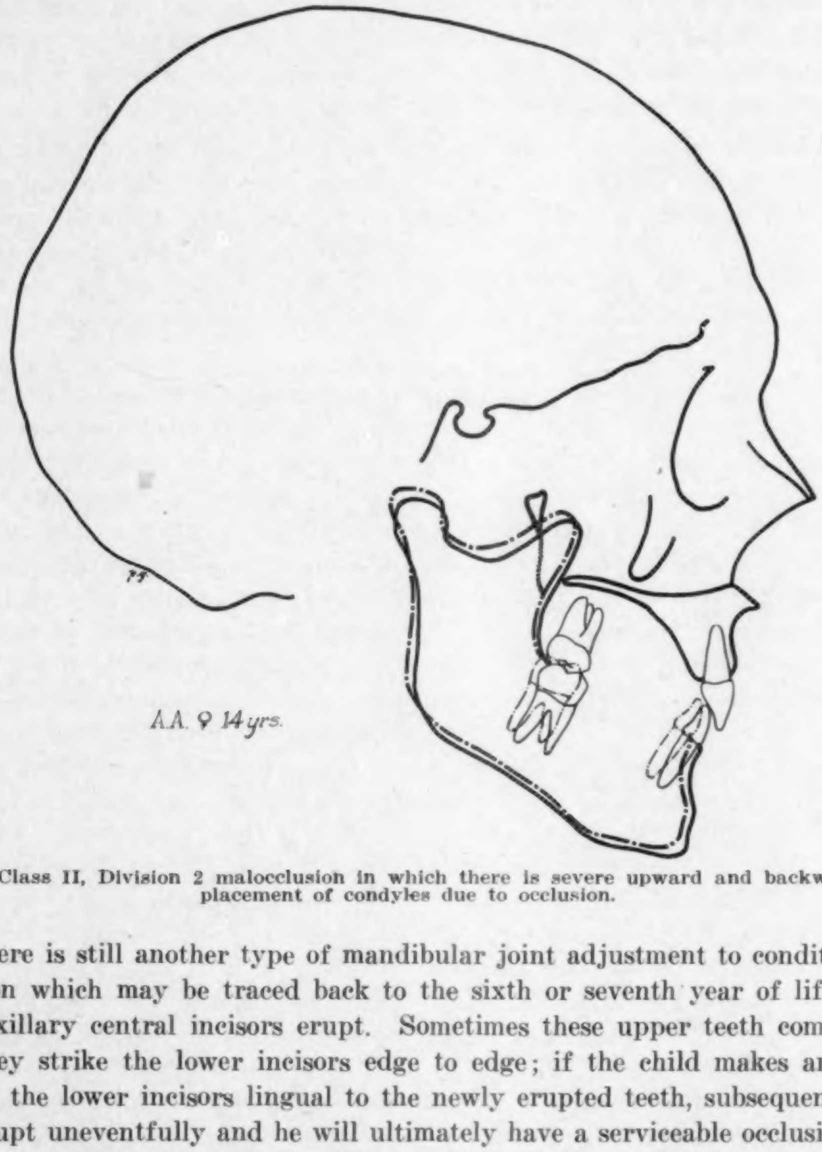

Fig. 3.—Class II, Division 2 malocclusion in which there is severe upward and backward displacement of condyles due to occlusion.

There is still another type of mandibular joint adjustment to conditions of occlusion which may be traced back to the sixth or seventh year of life when the maxillary central incisors erupt. Sometimes these upper teeth come in so that they strike the lower incisors edge to edge; if the child makes an effort to keep the lower incisors lingual to the newly erupted teeth, subsequent teeth may erupt uneventfully and he will ultimately have a serviceable occlusion. If, however, he elects to accommodate the newcomer by advancing the jaw, the upper tooth will settle lingually to the lowers and subsequently erupting maxillary incisors will also come in lingually. If this "accommodation bite" becomes habitual, he may reach adulthood with a malocclusion which, in the models, resembles the gross jaw abnormality called mandibular prognathism or Class III malocclusion. This pseudo-Class III, if the term is permissible, responds readily to orthodontic treatment, for the main problem in the young patient is to remove occlusal interference and permit the mandible to go back to its normal position. Many of the case reports on the successful treatment of Class III

malocclusion seem to have involved cases of this sort, and not the discouraging dentofacial disfigurement characterized by an obtuse gonial angle and a condyle which is in a retruded position in the fossa.

DENTURE PROSTHESIS

Earlier work[8] by Thompson than that cited above, undertaken in collaboration with Brodie, shows the significance of cephalometric findings in full and partial denture prosthesis. Their study of the masticatory apparatus revealed that the mandible is like the human scapula in that its position in space is determined not by articulation with other bones, but by a sling of muscles which maintains it through a balance of tensile forces. The teeth have been shown to affect very largely the position of the mandible when the jaws are tightly closed, but this position should be assumed only in the act of chewing. In the remainder of the time the position of the mandible, which we call physiologic rest, provides a small free-way space between the two dental arches. This position of the mandible is very constant and head films taken in this position may be duplicated again and again in the same individual; the balance of forces involves a chain of muscles which governs the posture of the head and includes the muscles at the back of the skull, the muscles of mastication, the suprahyoids, and the infrahyoids running down to the chest wall.

In order to determine the influence of the physiologic rest position in the success of denture prosthesis, these workers took physiologic rest films of edentulous patients prior to the construction of full dentures. When the dentures were placed, additional films were taken, and the vertical dimension established by the new dentures was compared with that of the rest position. This cephalometric examination was repeated several times during subsequent years to determine long-term changes. The results were very clear-cut: When the vertical dimension as established by the dentures was within the limits of the physiologic rest position so as to permit a small free-way space, the vertical dimension established was stable indefinitely, but when the rest position was exceeded, there was prompt resorption of bone beneath the dentures until the limits of the original rest position were attained and some free-way space was established. In those cases where physiologic rest was exceeded by partial dentures, there was not only resorption of bone in the saddle areas, but depression of the abutment teeth as well.

It was concluded from these studies that the precise balance between the muscles attached to the mandible cannot be disturbed, and that when the vertical dimension of the face at rest is increased by artificial appliances, the original proportions of the face and the balance between the muscles are re-established by degenerative changes.

The widespread interest in the dental profession in procedures which increase vertical dimension by means of entirely tooth-borne restorations suggests another avenue of study, to determine whether or not the rest position imposes the same sort of limitations upon this type of reconstruction work as it does upon full and partial denture prosthesis. The Division of Orthodontics and the Division of Crown and Bridge Prosthesis in the University of California College of Dentistry are collaborating in an effort to settle this question; all patients for whom this type of work is indicated are studied cephalometrically in the preliminary case analysis.

The clinical procedures used before the installation of the cephalometer are followed without regard to the data from the films, and consist of placing

an acrylic splint which is not unlike a partial denture with lingual bar, except that its principal function is to increase the height of the mandibular posterior teeth and to occlude (with properly carved anatomy) with the teeth of the maxillary arch. As in the past, this preliminary appliance determines the patient's tolerance for work of more permanent nature—crowns and bridges—which will establish the same jaw relationship as did the acrylic splint.

Additional films are obtained at completion of the temporary appliance and periodically thereafter, to determine the following: to what extent the new centric relation departs from the old, with respect to amount of opening and amount of advancement (where advancement was established); whether or not the new centric exceeds original physiologic rest position, and if so, by how much; whether or not the splints tend to establish a new physiologic rest position when observed over a number of years (not presumed to be likely at present).

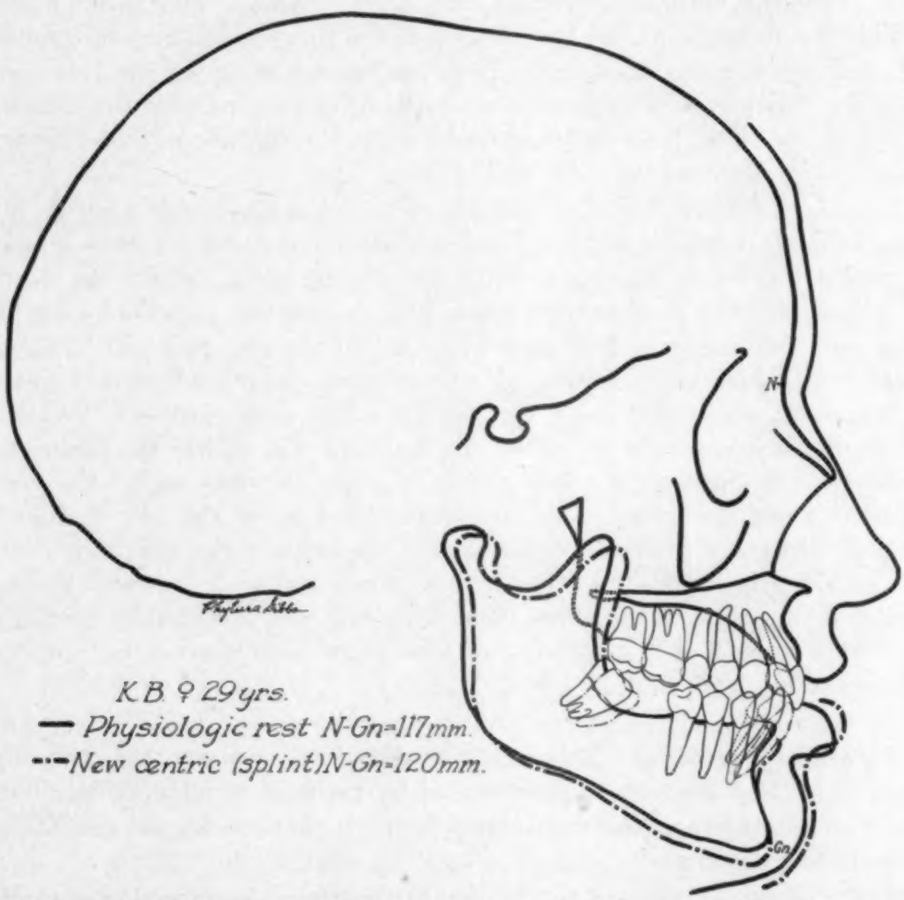

Fig. 4.—Case when bite was opened by means of acrylic splint to a position 3 mm. beyond physiologic rest. The mandible has been slightly advanced as well.

Fig. 4 is a typical case where the rest position is exceeded; the distance between the root of the nose and the chin-point (the most convenient means of measuring vertical dimension changes) has been increased beyond the rest position by 3 mm.; it should be noted that the mandible has been advanced slightly. This is justified by Dr. J. R. Gill, Chairman of the Division of Crown and Bridge Prosthesis, on the grounds that simple opening about the hinge axis of the condyles involves some posterior movement of the jaw as well, and accordingly a compensating amount of advancement is indicated.

Fig. 5 represents a more ambitious undertaking in crown and bridge prosthesis; the amount of opening adds 5 mm. to profile height above that obtaining when the teeth are in centric occlusion without a splint, yet physiologic rest is not exceeded, and the mandible is advanced 6 mm., primarily to correct a Class II jaw relation. Dr. Gill and I find our collaboration particularly interesting in that we are not in complete agreement on all points; the advisability of correcting jaw relationships by drawing the condyles forward on the articular slope is generally questioned in the Division of Orthodontics at California, although many orthodontists elsewhere make it a routine practice.

If the findings of Brodie and Thompson are ultimately found applicable to tooth-borne restorations as well as those entirely tissue-borne, one may expect that the vertical dimension established in Fig. 4 will progressively decrease until it is within the limits of the rest position, and that the prognosis for maintaining the new vertical dimension in Fig. 5 is materially better, since the opening at physiologic rest is not exceeded, in spite of the fact that the increment of opening is greater.

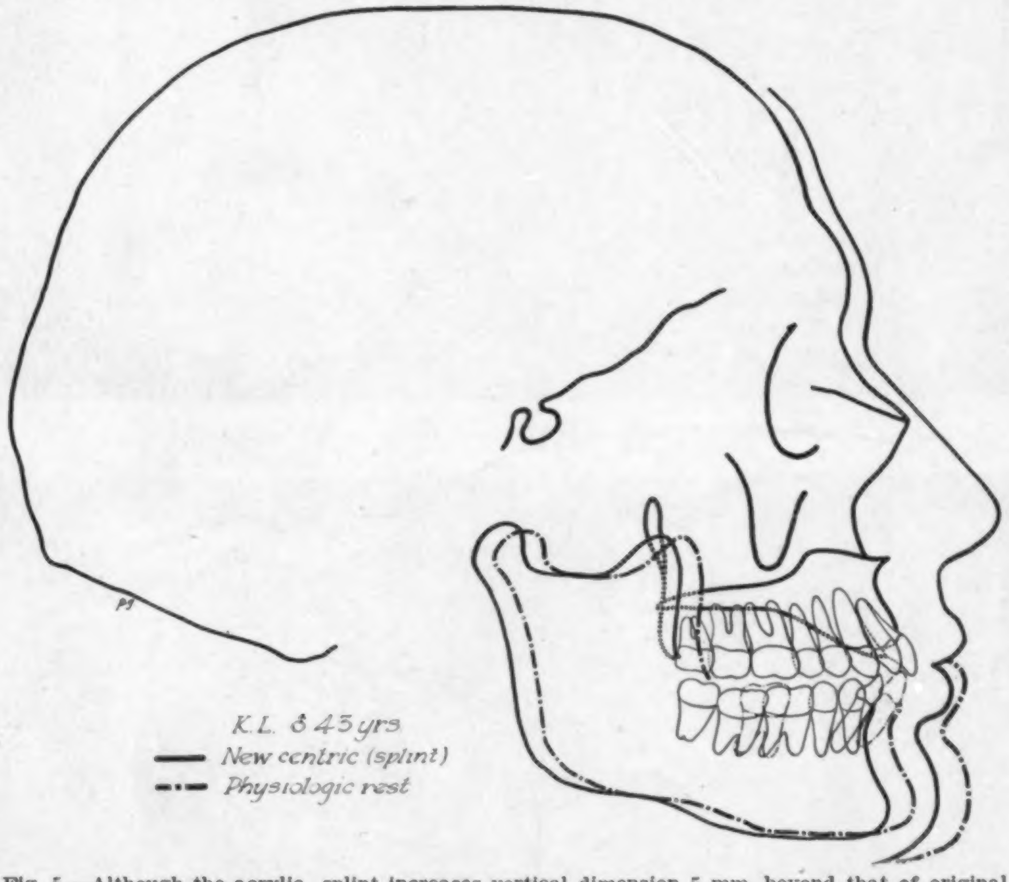

Fig. 5.—Although the acrylic splint increases vertical dimension 5 mm. beyond that of original centric occlusion, physiologic rest is still not exceeded. Mandible advanced 6 mm.

CASES REQUIRING MAXILLOFACIAL SURGERY

As Brodie[8] originally pointed out, no examination of the patient with mandibular asymmetry is complete until one has checked whether or not the asymmetry obtains with the mouth wide open as well as when the jaws are closed. The frontal film taken cephalometrically is particularly helpful in making a detailed study of the case, since all parts are projected to a single plane, and their relative positions in opening and closure are readily compared. Fig.

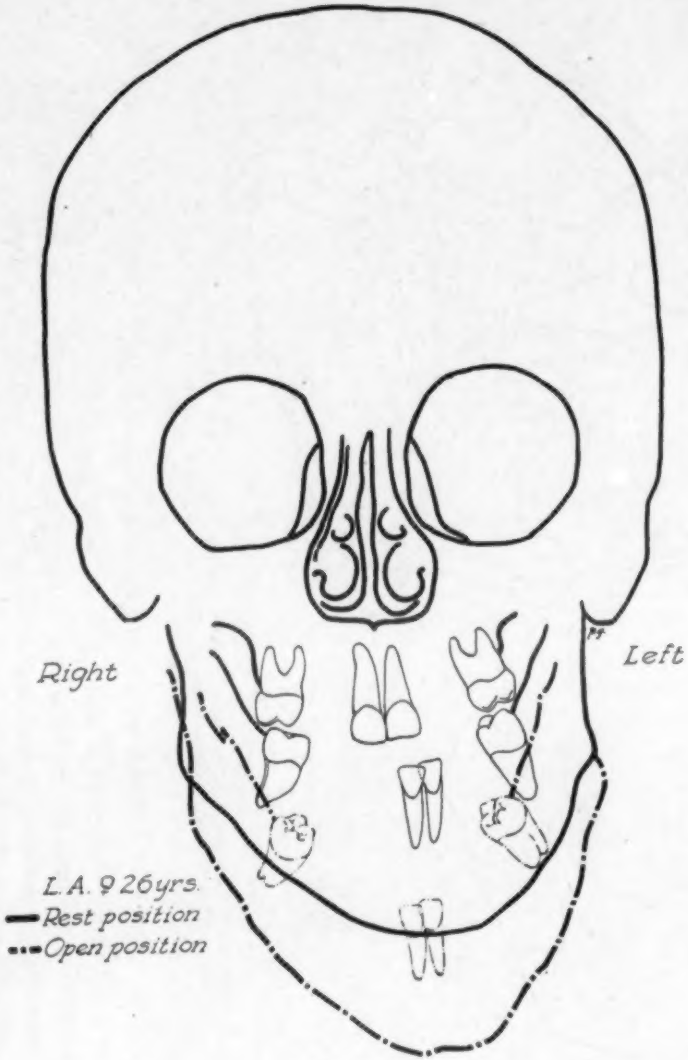

Fig. 6

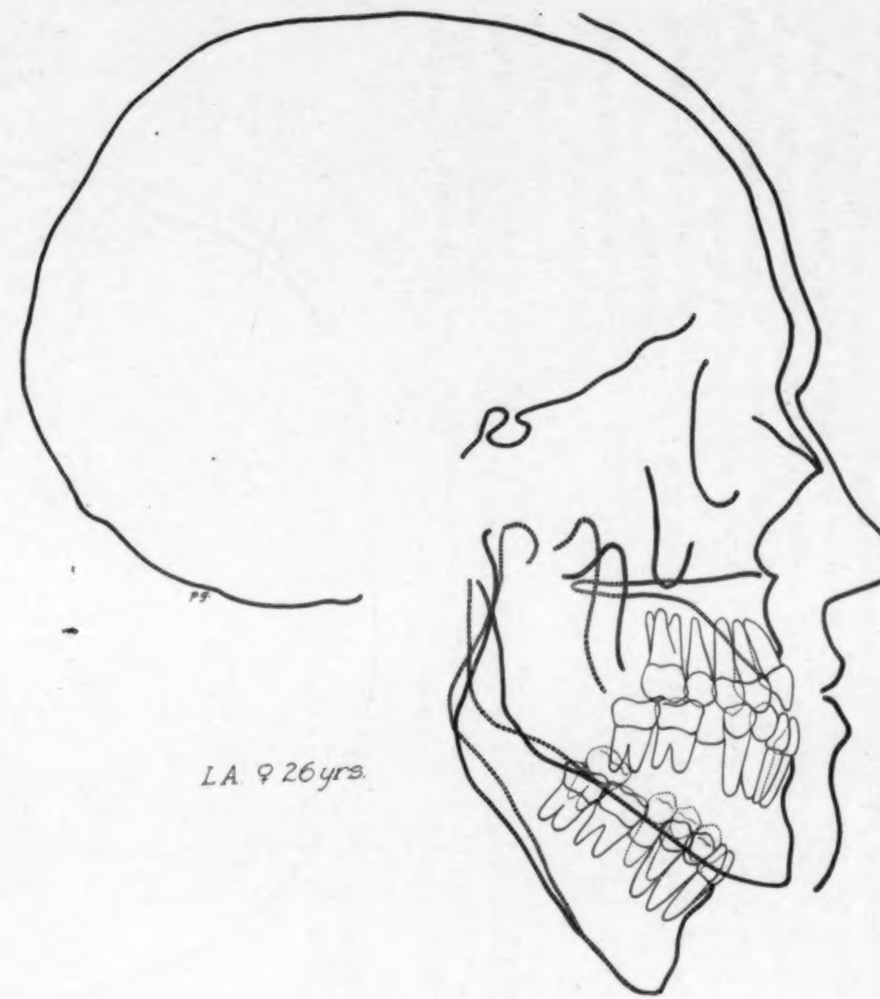

Fig. 7.

Fig. 6.—Mandibular asymmetry present when the jaws are closed, which corrects itself on opening.

Fig. 7.—Lateral view of same patient seen in Fig. 6. Note failure of rami to coincide in closed position, their superposition in the open position. Lower borders of mandible at same level when jaws are closed, asymmetric when jaws are open.

6 shows tracings from frontal films taken of a young woman whose mandibular midline deviated to the left of the facial midline by the width of a maxillary central incisor. On ordinary examination of the patient it appeared that the middle of the mandibular arch corrected itself when the jaw was opened, although the more precise record of the tracing shows that some asymmetry persists. Fig. 7 is from lateral tracings; the asymmetry shows in this aspect as a failure of the posterior borders of the rami to coincide. The forward position of the right side of the mandible is responsible for the prognathic profile. It should be noted that when the jaws are closed the lower borders of the body coincide with one another, but upon opening the right side drops below the left, while left and right posterior borders of the rami very nearly coincide.

Fig. 8.—Models of patient seen in Figs. 6 and 7.

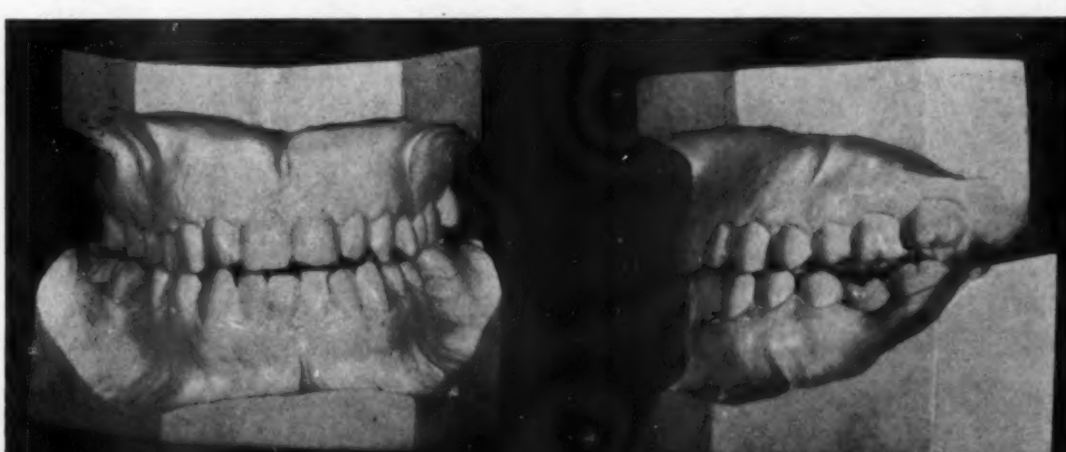

Fig. 9.—Occlusion immediately after osteotomy of right condylar process.

It is evident from this examination that some abnormality of the temporomandibular joint prevents the right condyle from reaching its proper position in the fossa at the same time that the left goes back normally. The possibility of a growth in the fossa rather than an involvement of the condyle is rendered unlikely by the data from the lateral films; opening the jaws brings the heads

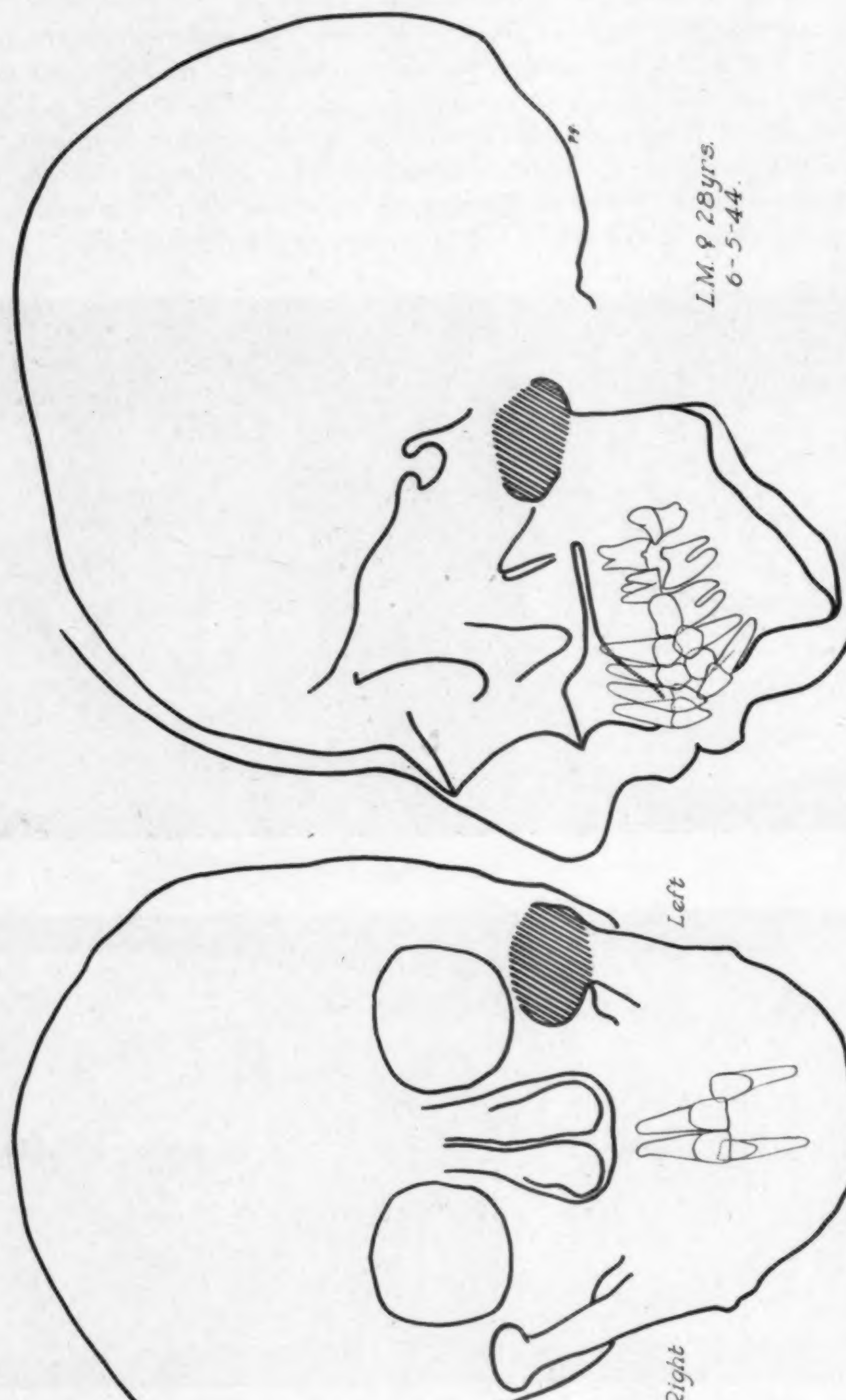

Fig. 10.—Schematic representation of egg-shaped mass of bone which joined left temporal bone to left mandibular condyle. Note facial asymmetry due to involvement of condylar head, an important growth site.

of the condyles forward on the articular slope, out of contact with any possible growth in the fossa, and all asymmetry should disappear if both condyles are normal. In this case, however, asymmetry not only remains but also manifests itself in a different way. Consider next the right condyle; an enlargement involving its posterior aspect would prevent normal movement into the fossa on closure. If the enlargement also involved the superior surface as it glided against the articular slope, it would tend to throw the ramus and body of the mandible on the right side downward. After obtaining a clear picture of the influence of the abnormality upon jaw function, an additional basal view was taken by routine roentgenographic methods which showed that the right condyle was approximately twice the size of the left. A unilateral osteotomy was recommended on the basis of the case analysis, and it was predicted that the occlusion would be changed by the operation from that seen in Fig. 8 to the more nearly normal relation in Fig. 9. Facial outlines were made entirely satisfactory by the operation, and the occlusion envisaged for the case was realized; a short period of orthodontic treatment and the restoration of missing mandibular first molars with bridgework will complete the necessary work.

Another young woman presented a mild asymmetry of the face, with a far more serious complication—she had not been able to open her jaws for twenty years. At the age of 8 years she had picked at a small skin infection anterior to the left tragus, and shortly thereafter was unable to open her jaw. Cephalometric films revealed an egg-shaped, calcified mass which united the base of the temporal bone to the left mandibular condyle; the size and extent of the anomaly are indicated in Fig. 10. This case demonstrates the importance of the head of the condyle as a site of facial growth; the lack of development on the left side and the resultant asymmetry are apparent in both frontal and lateral tracings. Unilateral osteotomy of the left ramus made it possible for her to open her mouth once again, and the badly broken-down posterior teeth have been removed.

The frontal and lateral head films in Fig. 11 are those of a young man of 18 years whose mandible was approximately the size of that of a 3-year-old. A bilateral osteotomy of the rami was performed and iliac grafts were placed to bring the mandible downward and forward. In analyzing the case we sought to estimate what the normal profile should be, by selecting from the files the normal mandibular outline of another individual. The precise manner of superposition was not immediately apparent; obviously the head of the condyles was one place for superposition, but how should we arrive at the vertical dimension? The procedure adopted is but one instance of the application of supposedly abstract and academic information to practical problems. Cephalometric investigations[6, 14] and a study of dried skulls[10] have shown that the nasal area contributes remarkably close to 43 per cent of the total distance from nasion to gnathion in all individuals. This well-substantiated observation was pressed into service in the following manner: The nasal height was measured and found to be 55.5 mm., which is 43 per cent of 129 mm. An arc of 129 mm. was struck from nasion, and the "borrowed" mandible was superposed on the head of the diminutive one so that the chin fell on this arc. The superposition completes the profile in an acceptable fashion, and even furnishes an estimate of the amount of extrusion which has taken place in the unopposed maxillary teeth. (See Fig. 12.)

Fig. 11.—Frontal and lateral head films of an 18-year-old male with mandibular development of approximately 3 years.

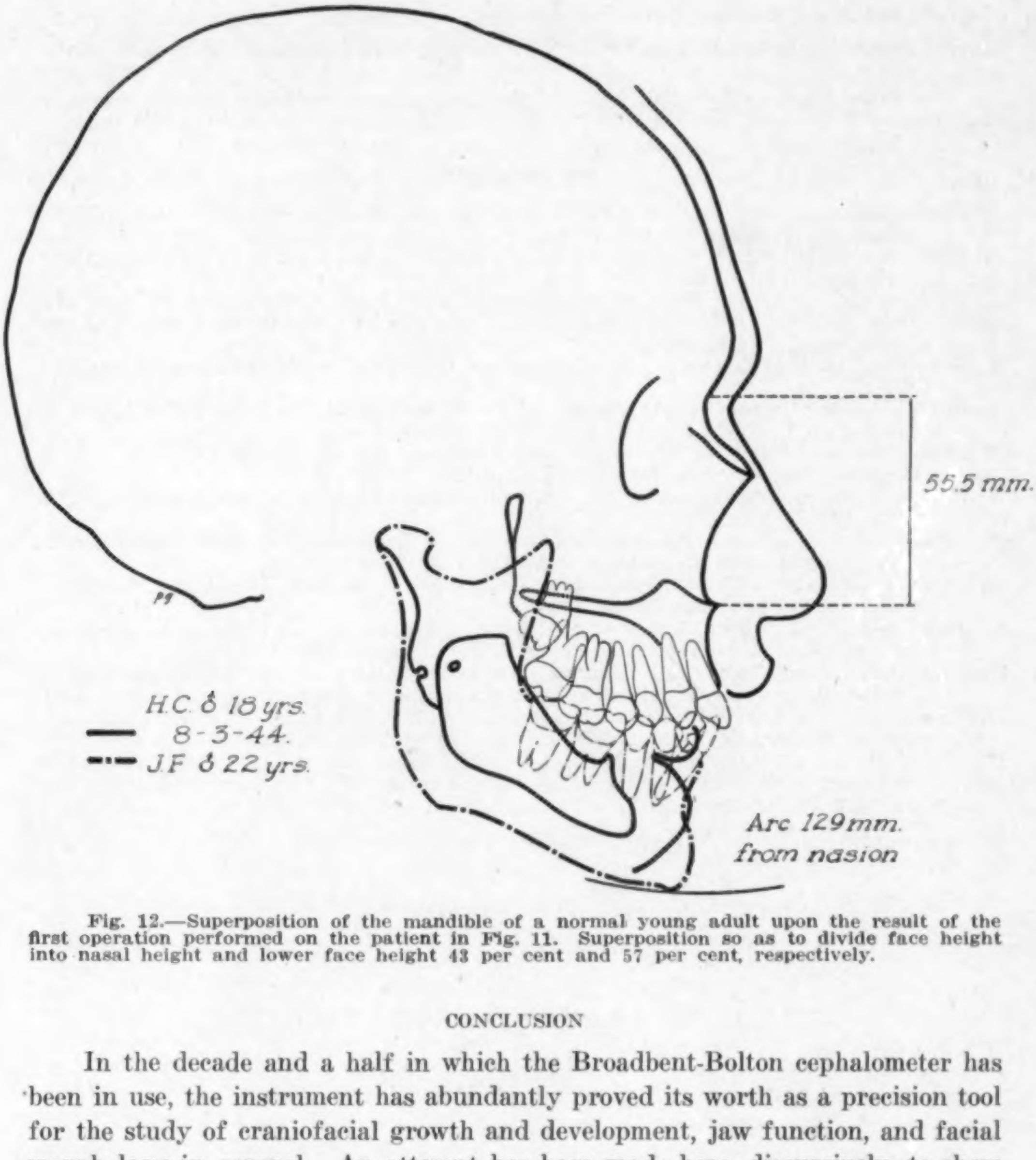

Fig. 12.—Superposition of the mandible of a normal young adult upon the result of the first operation performed on the patient in Fig. 11. Superposition so as to divide face height into nasal height and lower face height 43 per cent and 57 per cent, respectively.

CONCLUSION

In the decade and a half in which the Broadbent-Bolton cephalometer has been in use, the instrument has abundantly proved its worth as a precision tool for the study of craniofacial growth and development, jaw function, and facial morphology in general. An attempt has been made here, discursively, to show that orthodontists and students of growth need not be the only ones to profit from the ingenuity and the effort which have gone into the development of this apparatus. Already its role has been demonstrated in any restorative operations which go beyond teeth and alveolar process; interrelationships between occlusion and temporomandibular joint conditions have been shown, the long puzzling problem of vertical dimension has been partially clarified, and the maxillofacial surgeon finds the instrument a diagnostic aid. It seems not too much to expect that the applications of the technique will be increasingly extended, for all workers in the field agree that much remains to be done.

Toward the close of the nineteeth century Lord Kelvin said, "When you can measure what you are speaking about and express it in numbers you know something about it; when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind." To cite that statement with complete approval does injustice to many workers whose endeavors must always remain primarily qualitative rather than quantitative, yet the observation has a message

which is not always fully appreciated. The expression of observations in quantitative terms leads to objectivity, and from objectivity come hard-headed facts.

The writer has Dr. Harry Blackfield of the University of California Medical School to thank for the privilege of working with him in the surgical cases referred to in this paper.

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NATURE'S PLAN AND ORTHODONTICS

BYRON O. HUGHES, PH.D., ANN ARBOR, MICH.

MEMBERS of the Southern Society of Orthodontists and Guests: Today I would like to continue with you a discussion that has been carried on both before organized groups[1] of orthodontists and individual members of the orthodontic profession since 1936. This continued discussion has always been characterized by a freedom which has permitted the discussants to present facts, interpretations, and opinions centered about the practice of orthodontics, and has provided an opportunity to examine more critically the knowledge founda-

[1]This particular discussion was brought to a focus in the Eighth Denver Summer Seminar meetings in 1944. The contributions made by this group are gratefully acknowledged. The members present were Drs. Cecil G. Mulier, Isaac Schour, S. D. Gore, George H. Herbert, Brooks Bell, George H. Siersma, Harry R. Faulkner, Martin J. Mayeau, Louis S. Winston, Wm. M. Pugh, Wm. R. Humphrey, Fred E. Sims, Archie B. Brusse, Howard Yost, Wayne White, D. C. Miller, Mark H. Perrin, Nate G. Gaston, Mayor Thomas Williams, Drs. George L. Turner, Wm. Weichselbaum, Wm. A. Giblin, Major Ernest Klein, Dr. John E. McDermott, and Capt. Chas. Russell. In addition to these members of the seminar, I wish to recognize the many contributions to my thinking and the patient guidance given me by the following members of the Orthodontic profession: Drs. George R. Moore, Allan G. Brodie, Milo Hellman, Charles M. Waldo, A. LeRoy Johnson, Vernon G. Fiske, Andrew F. Jackson, and Thad Morrison.

This paper does not attempt to present new material. It attempts to summarize and to review critically some of the old. If, in critique, a conclusion or an idea is dealt with harshly, no reflection on the character or intelligence of any person is implied or intended. It is hoped that the language of presentation is sufficiently clear and vigorous to insure notice of the materials under consideration. And, finally, it is hoped the progress in the science of orthodontics will make this paper obsolete as soon as possible.

tions upon which diagnostic and treatment procedures depend. As one of the discussants I must admit that these give-and-take examinations have not always been especially flattering to the ego and, at times, have left me the feeling that I am not quite bright. I trust that others have had the same reaction!

Aside from the immediate reflection a large amount of ignorance may cast upon my character, a critical examination of what I know in order to ascertain more clearly and specifically the nature and extent of my ignorance has been useful as a stimulant to further investigation. This morning, then, I want to think aloud about biologic concepts and principles and the practice of orthodontics. As an aside, I want to remark that I do not practice orthodontics and do not have the experience which is so necessary to give meaning to the ideas I wish to present. Let me emphasize that practice often serves to point out the difference between what we *know* and what we *think we know*. Certainly every orthodontist should be able to treat malocclusion successfully; presumably he also should know in considerable detail the attendant circumstances of each case so that the treatment is preceded by an understanding of *why* as well as *how* it should be done. In other words, treatment should proceed from the brain of the orthodontist rather than from his fingers, and succeed *because* of what he *knows* rather than *in spite of* whit he *believes*.

With this rather long and somewhat divergent introduction, I would like briefly to turn to some of the contributions of Edward H. Angle. Angle generally is regarded as the founder of the orthodontic profession in this country and his contributions both to the practice and theory of orthodontics have been of outstanding importance. It is not my purpose here to minimize in any way the importance to orthodontics of Angle, of his work, or of his many students. Several of the principles voiced by him are still sound in the light of present-day knowledge; some are not. These need to be modified or discarded if we are to keep abreast of recent advances in understanding. I quote Angle[2] on this latter point:

> "Now this, our first annual meeting, will be of value to us and to humanity just in proportion to the earnestness, sincerity and spirit of progress that we bring to it. Shall we make it a prominent mile-post in the progress of orthodontia, or shall we spend this precious time, as the time of so many societies is spent, in useless chatter, in passing 'bouquets,' in boasting and self-exploiting, in political intrigue, in listening to inconsequential papers carelessly prepared on unproved theories, on 'borrowed' ideas, without credit, on the time-honored, thread-bare re-introduction of long-discarded or superseded mechanisms for treatment? Such papers, unfortunately, still largely predominate in the published literature of orthodontia, but no science was ever pushed forward by such means. The things worth while in orthodontia are easy to explain and to understand, but [italics mine] *they can be mastered and made of practical benefit only by the eternal application of thought, of reason, from basic principles, constantly and accurately applied.*"

I am not sure that "the things worth while in orthodontia" are easy either to explain or to understand; I do agree with the latter half of the statement, but I would expand and state that thought and reason should be applied accurately and continuously to an ever-increasing body of carefully collected facts so that the *relevancy of opinion to fact will consistently be maintained.* I further would argue that basic principles should be reliable and precise generalizations established from large bodies of well-collected facts. This point of view attests to the continued need for adequate matériel to be thought about and the relative uselessness of critical thinking with an absent or insufficient

[2]Excerpts from an Address of Welcome given by Dr. Angle at the First Annual Meeting of The Edward H. Angle Society of Orthodontia, Pasadena, California, June, 1922. Printed in *The Angle Orthodontist* 1: 8-12, 1931.

amount of dependable observation. In very plain words so you may not misunderstand me, I hold the opinion—attained through reading of orthodontic literature and through conversations with orthodontists—that too much attention is paid to "basic principles," concepts, and opinions, and too little to refined and critical observation of the facts contained within an individual upon which, finally, *the treatment of any case must depend!* Irrespective of what may be known as a generality, or of what may be believed, there can be no excuse for failure to observe. And if the held opinion fails to coincide with the observation, modify the opinion, not the observation. Now to be downright nasty in the hope that I provoke a reaction: I sometimes am afraid that orthodontists are so busy getting stuffed with biologic principles that they are becoming malnourished through failure to provide some observational vitamins. And I become just a little perturbed when I attempt to find the meaning in a phrase like the philosophy of an appliance. I can understand techniques or appliances for the treatment of malocclusion, but when appliances as well as orthodontists have to have a philosophy this is going a bit too far. This, perhaps, is quibbling over words and need not continue further. We always will need to answer these questions: what are your facts, sir? and how did you attain your opinion? Dr. Angle stressed this point when founding the orthodontic specialty and seldom missed an opportunity in lecture or writing to give added emphasis and further warning to his colleagues and students. Hellman, Jackson, Johnson, Howard, Broadbent, Brodie, and many other American orthodontists have continued in the excellent tradition about advancing understanding set down by Angle for orthodontics. There still remains, however, too many—and they write and talk too much—who appear to me to be too complacent, too facile of tongue, and too uncritical to do other than hinder the advancement of understanding in orthodontics. We should be well aware that we know too little, that we need to know much, and rather than pat ourselves on the back for our discoveries we need to seek more rigorously to do something about our ignorance. Let me emphasize: There are no gods in science.

Angle called attention many times to the points given above; he did not recognize expediency and believed in the attainment of the ideal in practice through concordance of treatment with the fundamental laws of nature. He says,[3]

> "We must consider the numerous possible changes which may follow the movement of teeth into correct positions, with the restoration of the natural functions of the occlusal planes, and the assistance the changes will lend to Nature as they stimulate her to efforts for the continuation of normal growth and development of all the related parts, that they may be in best harmony with Nature's plan, as well as with each other in their new relations. It is now well known that the structural changes which follow the correction of malocclusion are often pronounced."

In this section of a paragraph from Angle's *Malocclusion of the Teeth and Fractures of the Maxillae,* I want to call your attention to some items which will be developed later; they are: natural functions, stimulate her (Nature's) normal growth, and Nature's plan. Another paragraph[4] from the same work adds two more items and one statement of a relationship: malocclusion, normal occlusion, and "Malocclusion is but the perversion of normal occlusion." Later,[5] normal occlusion is modified to "ideal normal occlusion." This concept of the ideal normal occlusion becomes the basis for the classification of occlusion and

[3]Angle, Edward H.: Malocclusion of the Teeth and Fractures of the Maxillae, ed. 6, Philadelphia, 1900, S. S. White Dental Mfg. Co., p. 4.

[4]Ibid., p. 6, paragraph 2.

[5]Ibid., p. 6, paragraph 6.

is a useful, although arbitrary device, for the systematizing of observations about occlusion. The convenience that the classification system may have is recognized; the implications proceeding from normal occlusion should not be ignored. Time does not permit development of many of the above-cited items. As we follow the development of the thesis on Nature's plan and normal occlusion, we start with a *concept of normal occlusion* and end with a *law of Nature* and find that Nature provides normal [i.e., Angle concept of ideal occlusion—brackets mine] occlusion, and nonnature—nutrition, habit, trauma, developmental arrest, etc.—provides mal- or nonnormal occlusion. After the concept of normal occlusion had become a law of Nature, there was formulated a large array of concepts that covered almost every phase of biology about the way in which Nature's plan would become modified or perverted, and these became the etiological and diagnostic bases that were used to formulate treatment policies.

It is not important here to present a list of seemingly endless articles that have provided further speculation and opinion about the above-listed points. It is important to emphasize that these opinions have multiplied and, like rampant caries in the dentition, have become extensive both in the literature and in discussion with very little evidence that close attention has been paid either to the collection of pertinent facts or to the exercise of intellectual acumen to these observations in the attainment of an opinion or an understanding. Surely this is not scientific inquiry; it is more analogous to a malignant growth acting as a parasite to destroy finally the organism that supports it.

Let us, then, take a look at this vast and complicated array of phenomena we so easily contain in the little word we call *nature* and follow with a brief excursion into an equally complicated universe we term *nurture* or environment.

Life is a continuity which can be maintained only by an ever-present nurture in a place or environment. We do not know, in more than a general way, what life is or how it came into being. We are aware of some of the differences between the animate and the inanimate; whether these differences are of kind or pass insensibly one into the other we are not sure. Away from the borderline areas of life and nonlife some factors are sufficiently clear and extensive to warrant formulation into principles or laws of Nature. That is, they constitute our understanding of how Nature (life) operates. Two of these principles have been stated: Life is a continuity and nurture must always be present to maintain life. Life is always contained within individuals who are born or conceived, mature or grow, become old, and finally die. Life is transmitted from one or more individuals to another—the phenomena involved during this transition usually are termed hereditary or genetic—with a resultant that each individual is new only in a limited sense. In the majority of respects he is very old. Many who look at a new baby are impressed with the newness of life which they expect to manipulate and mold at their will. The baby is new. The life he contains is likely to be a half-billion years old and we need to recognize that the baby will continue this life, permitting minor deviations only, whether *we will it or no!* It seems rather naive to me to expect to accomplish major modifications upon millions of years of life by a year or two of treatment. The science of paleontology is devoted to understanding the nature of this life process. The occlusion of any individual you view—normal or otherwise—goes backward in time through countless generations and even beyond the presence of teeth. This holds true for other parts of the dentofacial complex. The facts

supporting this are so numerous and the exceptions so few we may conclude that continuity of life contained in individuals who are born, mature, grow old, and die is an essential part of *Nature's Plan.* There is considerable justification in calling this process normal and departures from it abnormal.

Nature, apparently, has other plans in addition to the one just stated. She continues life but produces individuals. In the production of individuals, variation rather than consistence appears to be the plan or law of Nature. Here, from my point of view, Nature exercises little or no discrimination; she provides endless variations: some bizarre, some useless, some detrimental, some helpful, in the nurtural and environmental circumstances into which an individual is born and lives. There is little evidence to support an opinion that Nature imposes a different set of living circumstances upon a detrimental variation than she does upon a favorable one. A general requirement by Nature for all variations is evident: the nurture and environment shall be appropriate to the specifications set up in the variation or injury and/or nonnatural modification will result.

Differentiation and growth are natural laws or processes which operate within individuals and, except in a very limited sense, do not function between individuals. In so far as the life process is concerned, an individual is an adult at the time he is conceived. In addition, he is slightly more mature than his parent or parents. As an individual he develops from conception to maturity; the life he contains always is at the mature level and if he fail systematically to adapt his functions and structures to his continued life, Nature emphatically and without exception imposes death—in part or as a whole.

Recent work on growth in the dentofacial complex, utilizing observations from serial roentgenograms, reveal the consistence and orderliness of the growth process within individuals. I call your attention to the excellent articles of B. Holly Broadbent, Allan G. Brodie and students, Schour and Massler, MacDowell, and Highley illustrating and discussing the way many parts of the dentofacial complex grow within individuals. In addition, differences between individuals are clearly shown. In all of this work there is little to indicate malocclusion to be a consequence of some kind of perversion of these natural growth processes. Certainly I can place but little faith in the concept of "developmental arrest" as a plausible explanation for more than a very small fraction of malocclusions. At the moment, attributing malocclusion to developmental arrest seems but a facile way of saying that the etiology is unknown. I suggest the concept be discarded until its reasonability be established at a considerably more precise level. In addition, these works enable us to think more critically about our ability to retard or stimulate growth. We may be sure that it is not easy to do, and fairly certain that our attempts to stimulate growth usually are not successful. So far, I have been little convinced that the results of stimulating, and perhaps of retarding, growth processes are much different from letting Nature alone. The number and variety of appliances and gadgets used by orthodontists to stimulate, to retard, or to change growth in one or another part of the dentofacial complex is very great. These require time and skill to produce; they are expensive to the patient; and frequently decidedly inconvenient to wear. All this and more too—apparently a hope therapy, an endlessly continued illusion—based on a concept, not based in fact. Somehow, somewhere, a malocclusion is a manifestation of Nature perverted from her ideal ways by multiple invidious influences open to our speculation but not open to our examination. *Ipso facto,* let us do something, do anything, that will "*un*-pervert" and stimulate Nature to grow normally and to produce ideal occlusions according to her plan. If mechanical stimulation does not work, try the endo-

crine glands. A beautiful picture, Gentlemen, and a credit to the logic that begins with the conclusion and adduces the supporting facts. I have only one criticism to offer: the concept is not consistent with reality so far as reality may be estimated from observation and analysis.

Let me repeat an earlier statement, "There is little evidence to support an opinion that Nature imposes a different set of living circumstances upon a detrimental variation than she does upon a favorable one." Nature produces a large number of individually varying parts in the dentofacial complex; these parts are juxtaposed in a more or less uniform way to produce occlusion. Some of the arrangements are regarded as undesirable by the orthodontist. These he terms malocclusions. Others he regards as desirable and calls normal occlusions. The distinction between the malocclusion and the normal occlusion is made by the orthodontist; not by Nature; and rightfully so!

This distinction about who gives definition to the normal or the abnormal, Nature on the one hand or the orthodontist on the other, is more than a mere toying with words. It implies that "Nature" and the orthodontist erected the definition from widely variant sets of facts. Nature provides each individual with a large number of variations or genes, arranged in diverse ways. As each new individual is created, these genes are scrambled into a new pattern, some genes are added, and some are lost. Once this genetic structure with its functional potentialities has been formed, the person having it has to get along with his nurture and environment as best he can. There are times when he does this well and we say he has good heredity. We mean that his heredity is consistent with his welfare. At other times the person gets some genes that are decidedly inconsistent with this ability to live. Here, we are in the habit of saying the individual has defective genes. I wish to emphasize that the genes are not defective; they go about their business of providing harelip and cleft palate, idiocy and other varieties of feeblemindedness, no teeth or some teeth, hemophilia and nonsight, and so on. The list is extensive and the defects vary from small to great. Some individuals get genes that terminate life rather abruptly—these are called lethal. In a rather awkward fashion we may say that Nature is concerned with the welfare of each of the genes but does not provide an administrative system or an executive to keep these genes cooperating with each other to maintain the welfare of the individual.

The orthodontist not only should be, but also is, concerned with the welfare of people, and it is toward this end that his planning is directed. In general, Nature does not exercise too much discrimination in planning her products to fit the environment in which they shall live. Consequently, she appears to have omitted environment as a consideration in the definition of normalcy. The orthodontist, on the other hand, views the problem of the normal and abnormal in terms of the "goodness of fit" between Nature and environment. If the fit is poor and the desirability of modification is evident, the case is classified as abnormal. Conversely, when the fit is good and there is no need for change, the case is termed normal. It is obvious that a definition of normalcy of this kind is attained by a consideration of circumstances contained within the individual and that what is normal will vary from person to person. This has been stated by Dr. A. LeRoy Johnson as the principle of the individual normal and, I believe, it should be the basis for the planning of treatment. Here attention is centered upon human welfare and the development of a treatment that will subserve these ends. Summarily stated, the orthodontist will proceed to change the person he has defined as abnormal into one he terms normal and that he will use any or all reasonable techniques at his disposal to produce this

change. If he wishes to term "mistakes" those factors which are detrimental to welfare, it is entirely within his province and convenience that he do so, since these are the items, irrespective of source, that he wishes to change. One cannot grant this point of view to the orthodontist without insisting, once and for all, that he discard the doctrine that Nature (heredity) does not make mistakes, and the policy of necessary cooperation with Nature as the only way to treat. Let me repeat: "The distinction between the malocclusion and the normal occlusion is made by the orthodontist; not by Nature; and rightfully so!"

Occlusions—whether we like them or no—may be mutilated (i.e., perverted). It seems to me that a very practical problem for the orthodontist is how best to mutilate occlusions he does not like, to produce what he calls normal occlusion; if mutilations have occurred that he regards unfavorably, how best to remedy them.

To this point, the argument has been concerned mainly with the proposition that the description of an occlusion—mal or normal—does not imply the process through which it was established, and that the conclusion that a malocclusion is the end product of an abnormal process or processes is unwarranted. That normal or malocclusions may not also result from mutilation has not been considered.

In any consideration designed to produce useful knowledge, it is necessary to order techniques of ascertainment in a systematic and consistent way. First, this involves a recognition of the circumstances under which the knowledge is to be used. Second, accurate and pertinent observation is resquisite to provide facts to think about. Third, the technique of analysis has to be appropriate to and consistent with the facts on the one hand and the desired occlusion on the other. The orthodontist is quite clear about the first point, at least in practice. He treats individuals and in treatment hopes, and more often than not attains, an occlusion that individually is desirable. However, he continues to talk and write as though he treated occlusions irrespective of where they may reside. He talks and writes about Class II, Division 1 malocclusion, and other really or plausibly associated generalities. Yet every time an individual bearing a Class II, Division 1 comes into his office, he has to outline an individual plan of treatment. Eventually he discovers that instead of treating a Class II, Division 1 malocclusion he has as many different treatments as he has patients. He may not be aware of a more important conclusion: the differences in treatment will be proportional to the differences in the individuals and not proportional to differences in the classification of occlusion. This is another way of saying that to classify an occlusion and to conclude about an occlusion are not equivalent. Treatment, presumably, depends upon the utilization of conclusions. Classification serves to allocate observations into various patterns, real or arbitrary, to attain efficiency and order of thinking.

If occlusions are consequences rather than causes and are contained within rather than between individuals, the way we should allocate our observations and utilize our conclusions becomes clear. The ordering of observation, analysis, and conclusion becomes centralized about a plan of treatment which has a reasonable indication for success within this individual. Whether this same plan would succeed for another individual is largely incidental and irrelevant. This latter statement is self-evident and should be a needless repetition of things all of you know and practice. An experience I had this summer while attending a clinical discussion of some treatment cases was so firmly impressed upon me, I feel obligated to summarize and transmit my opinion. A particular case serves as a focus. What its classification was or is need not concern us here. It is im-

portant to emphasize that the orthodontist who presented the case had not, at that time, attained what he regarded as a reasonable plan for treatment and he was seeking through discussion of his case with other members of the profession to outline a plan which would enable him to practice orthodontics on that patient. In a period lasting approximately thirty minutes, the case was reviewed by eighteen professional orthodontists. Fourteen observed less than two minutes and summarized their observations with concluding statements of the following order, "I had a case just like that, treat it this way . . . " Four observed carefully, asked pertinent questions, and directed their energies toward providing a respectable conclusion for the problem at hand. To finish the illustration; the discussion left the orthodontist annoyed and me astounded! This illustration is not given in censure; it does not exemplify the science of orthodontics; and *it should be needless repetition.*

The formulation of a treatment plan that offers a reasonable prognosis for success in modifying an individual to a desirable end point concords with at least one part of what I judge to be "Nature's plan." Nature produces individuals; it should, then, be our primary object to think about and to treat individuals. This procedure coincides with another part of "Nature's plan": those processes which maintain life always are contained within individuals and are interaction consequences or effects coming from two fundamentally different sets of facts. As mentioned before, one of these groups of facts is centered about the transmission of life from one or more individuals to another. As a convenience to our thinking we call them the facts of genetics or heredity. The other set of facts are used, primarily, in maintaining life, and in providing a place for an individual to live. These items we usually term nurtural or environmental. In other words, parents are required to create an individual and nurture is necessary to sustain him. *There is no point in the life of a person when heredity and nurture operate independently of one another.* This fact must be stressed again and again, and must be an integral part in the formulation of any treatment plan designed to modify or change an individual while, at the same time, adding to rather than detracting from his capacity to continue living.

For some reason—at the moment, not at all clear to me—after making independent assignment of a factor to heredity or environment, there are statements in the literature and in discussion to the effect that those items which come from heredity may not be modified and practice of orthodontics must be limited to modification of variations which come from the environment. This point of view is not true and should be excised from our thinking. The source of a variation, whether from heredity or from environment, *does not imply the amount by which it may be changed.* Limits to change always are present, sometimes large, sometimes small. In general, the likelihood of injury becomes great if one attempt to modify beyond these limits. While this is true and is used by all of you as a consistent part of treatment planning, it does not warrant the influence that heredity provides narrow and environment gives broad limits to change. Let me illustrate: the primary source of the variations requisite to the production of Class II and Class III malocclusions are hereditary; yet cases of these types of malocclusion are brought to successful conclusion by you daily. In some treatments a great deal of change is brought about easily, in others a small change is attained with difficulty, and in a few the changes produced appear to be resented by the organism and relapse occurs. Variations, which have environment as their primary source, are found very frequently in Class I, openbite. I need go no further with these since you are well aware of the many difficulties involved in treatment and retention.

Beyond recognizing that there are limits of flexibility or toleration to modification; that no general statement imputing differential flexibility, for variations of primary hereditary or environmental source, is warranted; and that toleration is defined individually and differs from person to person; there is little additional which may be said about this exceptionally important subject. I suspect the organism to be more tolerant to change during growth than after growth has ceased. There is evidence for a wider flexibility during periods of rapid growth and a narrower tolerance during periods of slow growth. Changes instituted in the direction the individual already is going appear to be acceptable to the organism, while those of contrary direction are rejected. And, finally, the utilization of time plus a small amount of the flexibility available at a given moment appears to provide a more satisfactory response to change than does the utilization of as much tolerance as is available in as short a time as possible. This latter statement could be termed a principle for the utilization of tolerance; it is fully in accord with available evidence and appears to integrate well with "Nature's plan."

In a sense, modern orthodontics really began when practicing men started to utilize tolerance in the treatment of malocclusion. In the language of the profession, changes in the position of teeth no longer were produced by moving teeth independent of other considerations. The response of the organism as a whole and of the tissues immediately adjacent to the teeth during the process of positioning became guiding factors in the planning and execution of treatment. Teeth no longer were merely moved; they were moved according to the limits imposed by the functional processes defined by the responding individual. The phrase "physiologic tooth movement" is a descriptive and meaningful designation of the vast difference between reasonably moving teeth when treating a malocclusion and just moving teeth. The phrase is easy in expression; its significance has been attained through years of careful observation and critical analysis with resultant conclusions that are useful in practice and scientifically sound. We should learn more about Nature's plan from researches like these.

An understanding of tolerances enables reasonable planning about the amount of change that should be attempted at any given time. Other knowledge becomes exceptionally important in planning how to use tolerance over a long period of time. Briefly stated, it is useful to know what Nature plans the adult individual to be like without having to wait for him to attain maturity before finding out. The old adage, "the child is father to the man," is an indicative generality. Its precision of estimate is too low, however, to be of much practical use. The orderliness of the growth process of the various structures within the individual makes it possible to determine what many of the subsequent changes will be. These have been pointed out in the work on growth previously referred to. Knowledge of the variations of other members of a family makes it possible for the orthodontist to see more clearly the individual design of each person within the family and to know better what the future holds for him. Certainly treatment planning should have some regard for the familial design toward which the organism is going. In practice, the data argue for the longitudinal study of each case to determine its natural direction and toleration limits and for the study of all available parental and sibling data to determine its past and future status.

As I review the discussion and argument of the extraction controversy, it seems to me that a detailed consideration of the above-mentioned points is re-

quired in each case before the question of extraction may even be considered. One may not presume upon Nature's intent and conclude that Nature intends normal occlusion, and nonnature, in some sort of perversive action, intends malocclusion. One may not assume that the classification of occlusion implies the process through which it was established and conclude that the malocclusion—so defined by the orthodontist—is the end product of an abnormal process, while the normal occlusion—also defined by the orthodontist—is the resultant of a normal process. The processes of establishment and the definition of occlusion may or may not coincide. The assessment of process and the assignment of occlusion are ascertained through independent procedures. The former depends upon a consideration of the interaction, within the individual, between those variations provided by heredity and those made available by nurture and environment. The latter is an estimate dependent upon a consideration of welfare, or the goodness of fit between the person and the world in which he has to live. It follows, then, that treatment planning is centralized about making changes which contribute to welfare and avoiding those things that detract from welfare. This makes the doctrine of cooperation with Nature untenable as a total philosophy for treatment planning; the concept of interference assumes coequal importance. An extended implication is: treatment planning shall proceed from facts and not from ideals, concepts, and philosophies. I would term comprehensive those treatments that have a reasonable utilization of the facts bearing on the case. I would call inadequate those treatments that are poorly supported in fact and/or ill conceived in analysis and conclusion. The term compromise does not make sense to me. Extraction is a method of carrying out a treatment plan. In itself it is neither compromise nor comprehensive any more than an edgewise, a universal, or a labiolingual appliance either is comprehensive or compromise. If censure is to be given let it be given to the one who extracts when the facts and reasonable consideration of them warrants a recommendation of nonextraction and equally to the one who fails to extract when the facts indicate extraction to be the most reasonable. A point of view which continually stresses the collection and utilization of facts in the planning and execution of a treatment designed to further the welfare of persons does not permit the focus of attention upon systems of treatment as ends in themselves. It states that a system of treatment is a means through which a reasonable plan may be accomplished. It emphasizes the selection of appropriate methods and stresses the need for continued development of methodological resources in order to have a wider range and greater flexibility in selection of techniques to subserve the plan of treatment. This point of view specifically denies the policy of *fitting the person to the method* to be valid. To me, the present extraction controversy resolves itself into an extensive verbalization about whether it is better to fit people into a method of extraction or more judicious to fit them to a system of appliances. The many references to and assumptions about Nature's plan or intent appear largely to be fallacious, irrelevant, or unnecessary. To put it bluntly, I think the controversy represents a wasteful utilization of valuable time and energy.

Finally, let me thank you for this opportunity to think aloud. I have stressed the importance of collecting and utilizing facts in planning and carrying out treatments on individuals. I have emphasized the danger of structuring the profession upon ideals, concepts, philosophies, and techniques of treatment. My concluding opinion is that orthodontics has been poorly scienced, and contrarily that, on the whole, it has been practiced well. I thank you.

THE DISTAL MOVEMENT OF AN UPPER IMPACTED THIRD MOLAR TO SAVE THE SECOND MOLAR

RALPH W. EATON, D.D.S., ROCHESTER, N. Y.

MANY second molars that are lost a few years after the removal of the third molars could be saved if the third molars were tipped distally to allow new bone to fill in before the tooth is removed.

In some cases, the third molar may be left to erupt in occlusion if there is an opposing tooth.

The same method of treatment is used on both upper and lower, except that the spring is shaped differently to conform to the soft tissues. A small cavity is drilled in the occlusal surface of the third molar to engage the wire.

Fig. 1.

Fig. 2.

Fig. 3.

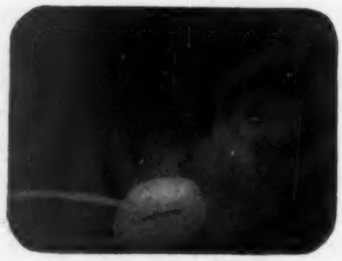

Fig. 4.

REPORT OF A TYPICAL CASE

The patient was a woman, aged 26 years, who presented on March 13, 1942. The soft tissue and bone were removed to expose the occlusal surface of the tooth. A removable lingual arch was used with bands on both upper first molars. The spring was tightened only three times during six weeks. After the tooth had been tipped the wire was left in place two months before the third molar was removed. There was no lower third molar.

Comment.—If the third molar had been removed before it was tipped distally, the cementum would have been exposed on the distal of the upper second molar, with a result that it would have had to be removed later.

16 NORTH GOODMAN STREET

Presented as a clinic before the American Association of Orthodontics, Chicago, April 25, 1944.

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Department of Orthodontic Abstracts and Reviews

Edited by

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Congenital Cleft Palate and Hare-lip in Infants: A Mode of Nutrition in the Pre-operative Period: By Hereford P. Taylor, L.D.S. Manch., *Brit. D. J.* 78: 1-7, Jan. 5, 1945.

In cases of cleft palate, whether simple or complicated, food will regurgitate down the nose unless precautions are taken. Obturators of both soft vela and hard rubbers have in turn been tried. Suffice it to say that, while mechanically efficient, these obturators produce a degree of oral inflammation which renders their use both impractical and undesirable.

An obturator conforming to the outlines of the cleft is constructed in soft rubber, to the palatal surface of which a form of teat is attached. Taylor has used two types of teat: (a) in cases presenting bilateral harelip as the complication; (b) where an alveolar cleft is coronally narrow and sagittally deep (Fig. 1). The other is a standard model as supplied to the general public. This is used (a) for cases of cleft which involve the soft and hard palates only; (b) for all cases where the complication is other than bilateral harelip (Fig. 2).

The completed appliance is coated with rubber latex in order to minimize tissue inflammation when in use. The teat is equipped with a hole of reasonable size to permit ease of feeding. Both types of appliance can be fitted to a feeding bottle.

Advantages.—The advantages gained by using either of the appliances illustrated are: (1) The food is obtained without regurgitation down the nose. (2) There is a minimum or total absence of tissue inflammation. (3) As the child is performing the act of sucking, muscular exercise is obtained and development of the facial structures proceeds in the normal fashion. This development is retarded or is absent when these infants are "spoon-fed." (4) The administration of the food is simple and completely without danger, as there are no mobile elements. (5) The infant is so nourished that at the optimum time for surgical intereference the case is an "excellent operation risk." (6) The appliance is easily kept clean.

Impression Technique.—Standard type trays are used for taking rough impressions. From these a special tray is constructed for each, either vulcanite or acrylic resin.

Satisfactory results have been obtained with the use of Ash's Dental Modeling Wax, No. 5, which has the advantage that, once softened, it is workable at temperatures well tolerated by the infant.

All impressions are taken with the infant in the recumbent posture, and it is a consideration of some importance that the infant cannot withstand a long and tedious impression technique. As the ultimate success of the appliance depends largely on it being adapted closely to the margins of the cleft, it is important that the cleft should be outlined clearly in the impression. A satisfactory impression having been obtained, a model is cast, preferably in stone. Following this, the outline of the cleft on the model is relieved with tinfoil. The cleft in the hard palate area is filled to within 1/3 inch of its free margin with wax which is covered with tinfoil. On this prepared model the cleft is now covered over in its entirety with a sheet of dental modeling wax. Single or double thickness may be used as required. This wax is

trimmed so that its periphery is 1/8 inch (approximately) beyond the margins of the cleft in their entire outline.

It now becomes necessary to separate the technique for the two types of appliance.

Fig. 1.—Appliance with constructed teat.

Fig. 2.—Appliance with standard teat.

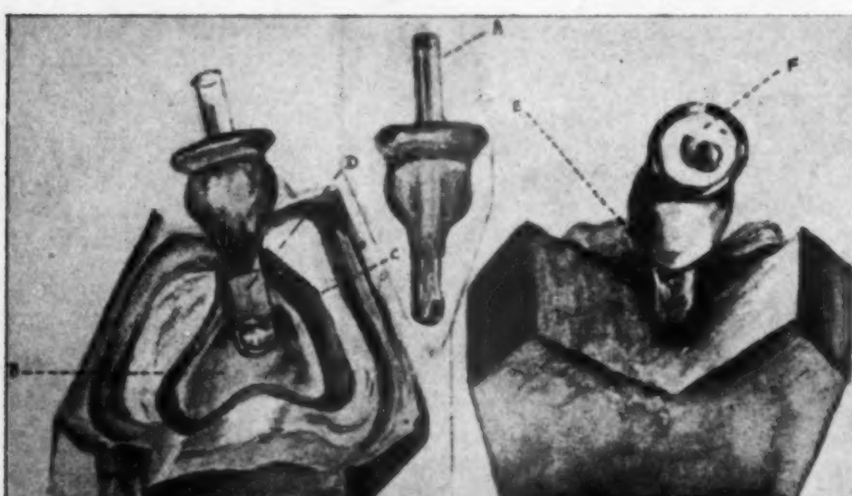

Fig. 3.—Details of constructed teat. *A*, Glass tubing slightly bent to allow for easy adaptation and correctness of position on model. *B*, Wax baseplate. *C*, Tinfoil relief. *D*, Wax film on glass tubing to give extra extension to teat. *E*, Wax filling narrow alveolar cleft with valve attached in position. *F*, Plaster to hold glass tubing in position.

Procedure When Using Constructed Teat.—A "valve attachment" is taken, such as is used on the normal feeding bottle, and the "nipple" end is cut off to leave an aperture of $\frac{3}{16}$ inch in diameter. Through this aperture is pushed a length of glass tubing of $\frac{1}{4}$ inch bore; the most suitable length is 2 inches. Previous to application to the valve, one end of the tubing is sealed by the local application of heat; it is then inserted through the valve. The remaining space in the valve is now filled with plaster of Paris, which, when

it has set, steadies and holds the glass tubing in its correct position. Thus prepared, the valve is waxed on the baseplate in the position shown in Fig. 3.

Embedding and Packing.—The appliance has now reached the stage when it may be removed from the model and embedded. This, together with "reversing," is performed in a normal fashion, the wax baseplate being kept uppermost.

The wax having been washed out, the exposed portion of the valve is thoroughly dried and treated with a solution of rubber in benzine. This causes the soft rubber mix, which is now packed into the flask, to adhere to the teat rubber. Trial closures are effected to ascertain that sufficient rubber has been added. On final closure it is recommended that a sheet of cellophane should be left in situ. Vulcanization of both types of appliance is performed at 20 pounds pressure for a period of twenty minutes.

Procedure When Using Standard Teat.—A standard teat of stout design is taken and filled with plaster of Paris. When the plaster has undergone its final set, the teat is quite rigid and may be waxed into position on the prepared wax baseplate (Fig. 4). It is advisable to lubricate the outer surface of the teat prior to positioning on the wax plate. When waxing the teat in position, the wax baseplate should be softened at the point of application, thus moulding the wax into shape, which readily accommodates the nipple of the teat as illustrated. The teat is now removed and the case embedded in the flask. After the wax has been washed out, the soft rubber mix is packed into the flask until sufficient has been added. Trial closures are performed as above. In this case it is most satisfactory to process the rubber between two layers of cellophane as this gives added finish.

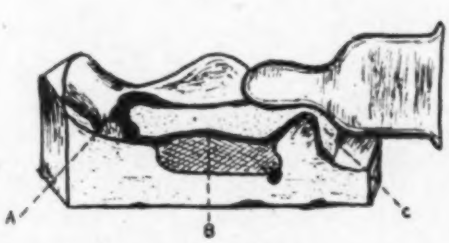

Fig. 4.

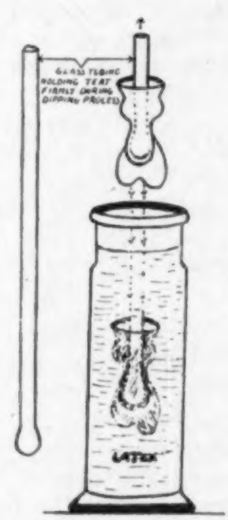

Fig. 5.

Fig. 4.—Sectional drawing through alveolar and palatal cleft with standard teat in position. *A*, Tinfoil relief. *B*, Palatal cleft filled with wax and sealed with tinfoil. *C*, Wax baseplate covering alveolar cleft and contoured to accommodate teat.

Fig. 5.—Method of applying latex to appliances.

Following deflasking, carried out in a normal manner, any excess of soft rubber is trimmed off, scissors being very suitable for this operation. This appliance is now cleaned with benzene and replaced on the master model to test the adaptation. Following cleansing, the teat is attached to the prepared rubber appliance in the position shown in Fig. 4. Four stages are recognized: (1) The teat and rubber are thoroughly dried, preferably with alcohol; (2) a solution of 5 per cent masticated crepe rubber in benzene is applied to the rubber appliance at the site where the teat is to be attached; (3) the two elements are joined and held in position for a few seconds until union is secure; (4) the case is left for an hour to allow the excess of benzene to evaporate.

This stage having been completed, the final covering can be applied to the whole appliance.

Application of "Latex."—The final stage of the technique has now been reached. This consists of the application of a "latex" coating to the appliance, and it is here that practice and patience are required to bring a reasonable measure of success.

The first requirement is a length of glass tubing of ¼ inch bore (approximately) 8 to 12 inches long. One end is sealed and while in the plastic state it is rendered bulbous by blowing gently down the tubing.

In the case of the standard teat, the glass tubing, prepared as above, is pushed into the teat, thus holding it rigid.

In the case of the constructed teat the glass tubing is pushed through, until the bulb at the end of the tubing is flush with the aperture previously made in the valve. This can be seen in Fig. 5. The appliance is thus held rigidly by means of the glass tubing. Over this glass bulb latex is coated and thus the similarity to the standard teat is obtained.

Application of Latex.—The stage has now been reached for the application of the latex and the method is identical for both types of appliance. The type of latex used is a "centrifuge-concentrated, ammonia-preserved latex" of approximately 60 per cent content of rubber. The steps in the process are as follows: (1) Dry the appliance thoroughly with alcohol, if available. (2) Dip the appliance into a 5 per cent solution of masticated crepe rubber in benzene. On removal, allow it to dry. (3) When the appliance is quite dry, dip it into the 60 per cent ammonia-preserved latex for 5 to 10 seconds. This is done as shown in Fig. 5. An even coating should be formed over the whole appliance. (4) Following removal from the latex, the appliance, with glass tubing attached, is rotated with an even motion until the latex is dry (i.e. there is no trace of opacity). (5) Repeat stages *2, 3,* and *4,* to apply a second coating. This enhances the strength and durability. (6) In the case of the constructed teat, a third and even a fourth layer may be applied over the glass bulb, to give added strength. (7) When in the operator's opinion sufficient latex has been applied and the final coating has been dried, the appliance is dipped into a vulcanizing solution consisting of: benzene 100 parts, sulfur 2 parts, zinc oxide 1 part, Vulcafor D.D.C.N. 3 parts, for ten seconds. (8) Following removal from the vulcanizing solution the appliance is allowed to dry in a warm atmosphere for a period of up to twenty-four hours in order that all traces of benzene may be removed. For this drying out it has been found very satisfactory to stand the appliance in a measuring cylinder by means of the glass tubing. (9) The final step is vulcanization for fifteen minutes in boiling water.

The glass tubing may now be removed from the appliance and a hole of suitable size made in the teat to enable the infant to obtain its food with comparative ease. A suitable size for the hole is one through which water will drip slowly out from the feeding bottle with the appliance attached.

The appliances can be fitted to a standard feeding bottle, though for these infants the half-size (4 ounce capacity) feeding bottle of Allen and Hanbury has been found to be very suitable. The feed is given in a manner identical with that for "bottle-fed" normal infants.

Human Embryology: By Joseph Krafka, Jr., M.D., Ph.D., Professor of Microscopic Anatomy, University of Georgia School of Medicine, Illustrated, New York, Paul B. Hoeber, Inc., 1944.

Krafka has prepared a short account of the development of man. Embryology is one of the few fields wherein medical science cannot point to marked advancement within recent years. The text of Keibel and Mall, published about 1910, is still regarded as not altogether out of date and many of their illustrations are still frequently found in current texts. It is now recognized that the growth of medical knowledge has reached a point where the student is no longer able to learn all that is known in a given field; for this reason Krafka's book was designed to include the basic foundation of the subject while omitting nonessentials.

The general development of the stomodeum is described and illustrated. Tooth development is largely taken from Orban's *Dental Histology and Embryology*. The book has an excellent index.

Medical Clinics on Bone Diseases: A Text and Atlas. By I. Snapper, M.D., formerly Professor of Medicine, Peiping Union Medical College, Peiping, China. Illustrated. Pp. 225. Price $11.50. New York, Interscience Publishers, Inc., 1943.

During the past twenty years, diseases of the bones have come to be recognized as being, in many instances, manifestations of disturbances of the various systems of the body. Medical and dental men are therefore interested in bone diseases since they are frequently in a position to make diagnoses. This book presents observations and x-ray pictures on the problems involved in bone diseases. A comparison is made of experiences in the Western hemisphere with observations made in China.

The relationship of bone diseases to the endocrine system in Recklinghausen's disease is now well known as is the metabolic character of the Hand-Schüller-Christian's disease. The manifestations of hyperparathyroidism to the diseases of bone are fully discussed, especially as they manifest themselves in the skull. A chapter is presented on avitaminosis D, as seen in rickets. Case reports are presented of the various bone diseases and include interesting illustrations of patients treated. The book has a complete index.

Clinical Diagnosis by Laboratory Examination: By John A. Kolmer, M.S., M.D., Dr.P.H., Sc.D., L.L.D., L.H.D., F.A.C.P., Professor of Medicine in the School of Medicine and the School of Dentistry of Temple University; Director of the Research Institute of Cutaneous Medicine; formerly Professor of Pathology and Bacteriology in the Graduate School of Medicine of the University of Pennsylvania. Pp. 1239. New York, D. Appleton-Century Company Inc., 1945.

Laboratory examinations are employed routinally to ascertain clinically unsuspected abnormal conditions, and as a specific diagnostic measure in establishing the presence or absence of clinically suspected diseases. In this volume Kolmer presents a working knowledge of the functions and normal values and abnormal changes of the blood, including its composition, coagulation, and changes in bone marrow. The same approach is used in the clinical interpretation of urine examinations and blood chemistry examinations, and in the interpretation of glucose tolerance kidney function, basal metabolic and iodine tolerance, and other tests. An interesting chapter is the one on clinical interpretations of examination of the saliva and sputum.

Kolmer warns that the normal saliva contains so many different microorganisms that great care must be exercised in the interpretation of results. A summary of the clinical findings of bacteriologic examinations of the mouth, gingivae, and teeth is presented.

Kolmer dwells on the role of dead teeth as potential and active sources of focal infection. Autogenous vaccines of periapical infection should never be made from the entire tooth. Only the amputated apex should be cultured.

While the dentist will find in this book a great deal which is not of use in his immediate field, he will, nevertheless, obtain much practical information on laboratory tests which he can perform himself and which will enable him to evaluate regular laboratory findings submitted to him from other sources. This knowledge will enable the dentist to obtain a better understanding of the medicodental relationship. The book has a complete index.

News and Notes

Philadelphia Society of Orthodontists

The recently organized Philadelphia Society of Orthodontists, which has chosen the American Journal of Orthodontics and Oral Surgery as its official publication, has elected the following officers:

President, Dr. John V. Mershon
Vice-President, Dr. Frederick R. Stathers
Secretary-Treasurer, Dr. Augustus L. Wright

Hospital Ship Dental Officers

Every Army hospital ship has at least one dental officer assigned to its professional staff, whether it is bringing wounded home, transferring patients from one theater to another, or supporting an amphibious landing operation.

The larger hospital ships carrying 900 to 1,500 bed-patients have a dental staff headed by a lieutenant colonel. On the 1,500-bed ships this staff consists of a lieutenant colonel who is a general dentist, a major who is an oral surgeon, and two captains or first lieutenants who are general dentists. The highest ranking dental officer on hospital ships, which carry from 500 to 800 bed-patients, is a major who is an oral surgeon, while a captain or first lieutenant who is a general dentist is assigned the dental responsibilities on the smaller 200- to 400-bed hospital ships.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, Archie B. Brusse - - - - - - - - - - - 1558 Humboldt St., Denver, Colo.
President-Elect, Earl G. Jones - - - - - - - - - - 185 East State St., Columbus, Ohio
Vice-President, Will G. Sheffer - - - - - - - - Medico-Dental Bldg., San Jose, Calif.
Secretary-Treasurer, Max E. Ernst - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Central Section of the American Association of Orthodontists

President, Arthur C. Rohde - - - - - - - - 324 E. Washington Ave., Milwaukee, Wis.
Secretary-Treasurer, L. B. Higley - - - - - - - 705 S. Summit St., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Willard A. Gray - - - - - - - - - Medical Arts Bldg., Rochester, N. Y.
Secretary-Treasurer, C. Edward Martinek - - - - - - 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, Raymond L. Webster - - - - - - - - - 155 Angell St., Providence, R. I.
Secretary-Treasurer, Norman L. Hillyer - - - - - - Professional Bldg., Hempstead, N. Y.

Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, Henry F. Hoffman - - - - - - - - - 700 Majestic Bldg., Denver, Colo.
Secretary-Treasurer, George H. Siersma - - - - - - 1232 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, Amos S. Bumgardner - - - - - - - - Professional Bldg., Charlotte, N. C.
Secretary-Treasurer, Leland T. Daniel - - - - - - 407-8 Exchange Bldg., Orlando, Fla.

Southwestern Society of Orthodontists

President, Harry Sorrels - - - - - - - - - Medical Arts Bldg., Oklahoma City, Okla.
Secretary-Treasurer, James O. Bailey - - - - - - Hamilton Bldg., Wichita Falls, Texas

American Board of Orthodontics

President, Frederic T. Murlless, Jr. - - - - - - - - 43 Farmington Ave., Hartford, Conn.
Vice-President, Joseph D. Eby - - - - - - - - - - 121 E. 60th St., New York, N. Y.
Secretary, Bernard G. deVries - - - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White - - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.
Claude R. Wood - - - - - - - - - - Medical Arts Bldg., Knoxville, Tenn.
James A. Burrill - - - - - - - - - - 25 E. Washington St., Chicago, Ill.

Harvard Society of Orthodontists

President, Francis J. Martin - - - - - - - - - - - - 1074 Centre St., Newton, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - - 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Meyer Eggnatz - - - - - - - - - - Medical Arts Bldg., Baltimore, Md.
Secretary-Treasurer, William Kress - - - - - - - Medical Arts Bldg., Baltimore, Md.

*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

St. Louis Society of Orthodontists

President, Virgil A. Kimmey - - - - - - - 3722 Washington Ave., St. Louis 8, Mo.
Vice-President, Leo M. Shanley - - - - - - - 7800 Maryland Ave., Clayton 5, Mo.
Secretary-Treasurer, Everett W. Bedell - - - - 1504 S. Grand Blvd., St. Louis 4, Mo.

Philadelphia Society of Orthodontists

President, John V. Mershon - - - - - - - - - 1520 Spruce St., Philadelphia 2, Pa.
Vice-President, Frederick R. Stathers - - - - - - - 269 S. 19th St., Philadelphia, Pa.
Secretary-Treasurer, Augustus L. Wright - - - - 255 S. 17th St., Philadelphia 3, Pa.

Foreign Societies*

British Society for the Study of Orthodontics

President, **S. A. Riddett - - - - - - - - - - 42 Harley St., London, W. 1, England**
Secretary, **R. Cutler - - - - - - - - - - 8 Lower Sloane St., London, S.W. 1, England**
Treasurer, **Harold Chapman - - - - - - 6 Upper Wimpole St., London, W. 1, England**

Sociedad de Ortodoncia de Chile

President, **Alejandro Manhood - - - - - - - - - - - - - - Avda. B. O'Higgins 878**
Vice-President, **Arturo Toriello - - - - - - - - - - - - - - - - - Calle Londres 63**
Secretary, **Rafael Huneeus - - - - - - - - - - - - - - - - - Calle Agustinas 1572**
Treasurer, **Pedro Gandulfo - - - - - - - - - - - - - - - - - - Calle Londres 63**

Sociedad Argentina de Ortodoncia

President, **Vicente A. Bertini**
Secretary, **Ludovico E. Kempter**
Treasurer, **Edmundo G. Locci**

Sociedad Peruana de Ortodoncia

President, **Augusto Taiman**
Vice-President, **Ricardo Salazar**
Secretary, **Carlos Elbers**
Treasurer, **Gerardo Calderon**

Asociación Méxicana de Ortodoncia

President, **Guillermo Gamboa - - - - - - - - - - - - - - - - - - Madero 34-3**
Secretary, **Rutilio Blanco - - - - - - - - - - - - - - - - - - Donceles 98-209**
Treasurer, **Carlos M. Paz - - - - - - - - - - - - - - - - - Av. Insurgentes 72**

*The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis 5, Mo., U. S. A.